HEALTH LECTURES

FOR THE PEOPLE

CONTENTS.

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TENTH SERIES.

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CONTENTS.

MAN: A MACHINE.

(*ILLUSTRATED BY EXPERIMENTS, MODELS, DIAGRAMS, &c.*)

By MACDONALD BROWN, M.B., F.R.C.S., F.R.S.E.

When asked by your Committee to deliver one of the Health Lectures for this session, I found no small difficulty in choosing a suitable subject. This difficulty was much increased by the fact that, in previous sessions, your Lecturers have discoursed on nearly all the more interesting problems connected with the anatomy of the human body.

It seemed to me, however, that it might prove interesting and instructive to most of you, if I reviewed, in a very simple way, the mechanism of the human body; and I was encouraged to do so by the belief that the consideration of man, viewed in the light of an intricate machine, might not only aid you in understanding better the other lectures of this course, but might also invest with a fresh interest the little everyday phenomena connected with our daily life.

It is a striking commentary on the advance of thought that, not only in all our large towns, but even in our villages and country districts, no class of lectures, in recent years, has met with such favour, as that which brings science within the grasp of the people.

Science in the past was a mysterious quantity, surrounded thickly by superstition, but during the past two centuries it has advanced with rapid strides, and more especially within the last few years scientists have endeavoured to share with the people some of the benefits which they themselves have derived from it.

At the present moment science threatens to revolutionise our system of national eduction by insisting upon its voice being heard in our schools on an equal, if not on a higher platform, than the time-honoured classics and literature, which, however useful they may be as a means of mental culture, are not applicable to the practical purposes of life. It is becoming more and more felt by the administrators of education in this country that our youth must know something of the world in which he lives, of the creatures which inhabit it, of his own wondrous mechanism, and of the laws which govern them and him.

The courses of Health Lectures which are delivered annually under the auspices of your Society are but an extension of this principle. Our people, intelligent and educated, feel the necessity of knowing something about themselves and the laws which regulate their health and well-being, and it is to satisfy this craving that this Society exists and labours.

Has it never struck some of you as being somewhat strange that, during all these years, you have been moving through this world of ours, seeing its beauties, tasting of its fruits, enjoying the perfume of its flowers, and hearing the music of its birds, and yet you do not know how you walk, see, taste, smell, or hear?

At the risk of being deemed materialistic, I think we may profitably spend our evening in endeavouring, in a concise, simple way, to review the various systems which constitute our bodies, —to study, in fact, man as a mere machine.

Like every machine, man possesses a framework, hard, substantial, and durable, which we know as the skeleton; a framework which is modified, not only to support various parts, but also to enclose and protect vital organs. The skeleton is made up of a vast number of separate bones, which differ in form and character in different parts of the body—thus we have long bones in the limbs, flat bones in the skull, and bones irregular in shape in the spinal column. To describe the skeleton fully, even in a popular way, would occupy several lectures, were the subject to be gone into at any length. Suffice it to say that supporting the skull is a long chain of bones known as the spinal or vertebral column, which below is firmly wedged into the pelvis,—a column which supports the ribs and breast bone, and to which indirectly the limbs are articulated. In the limbs especially, the bones

form a system of levers, by the actions of which the various movements we are accustomed to perform are produced. In the chest, the sternum or breast-bone, with the ribs and their cartilages, form a framework, which encloses those vital organs the heart and lungs. In the pelvis the bones are expanded so as to aid in supporting the organs or viscera of the abdomen. And lastly, in the head and back, they provide the skull and spinal canal, cavities which lodge the brain and spinal marrow. In the skull, in addition to the mere case which serves to contain the brain, there exist various bones, upon which are modelled the soft structures of the face.

In order that these separate bones may be firmly attached to each other, it is necessary that they should be jointed together. The joints of the body vary in form and character; in some, as in the skull, no movement exists, in others the movement permitted is extremely slight (*e.g.*, between two vertebrae), but in the most important group, the movements capable of being performed are free and extensive.

Bone is a hard substance, and were two bones merely held together by fibrous bands or ligaments, the movements which could be performed at such a joint would be rough, unequal, and difficult. Nature has, however, constructed in the most ingenious method an apparatus by which roughness is removed, friction reduced to a minimum, and great delicacy of action provided. Thus in such a joint as, for example, the shoulder, the bones have their opposing surfaces coated with gristle or cartilage, a substance which, although tough and of firm consistence, is yet largely elastic. By means of it the bones fit accurately with each other, and all jolting is done away with.

In addition to this, the bones are held together by a strong fibrous capsule, on whose inner surface is a delicate shining membrane, which secretes or produces a small quantity of viscid fluid. This fluid acts as an oil to the joint, and being constantly produced every day of our lives, it keeps our joints at all times perfectly oiled.

We have thus far constructed the Human Machine, given it levers, furnished it with joints; we must now supply it with apparatus by which these levers can be moved. The movements of the different parts of the body are brought about by means of muscles. These muscles constitute the flesh or beef.

It is a little difficult at first to realise that beef, which one is accustomed to regard as a uniform substance, as seen in a joint of meat, is capable of being split up by the dissector's knife into a number of distinct portions called muscles, separated from each other by delicate fibrous sheaths, which endow each muscle with a certain amount of independence of action.

A typical muscle consists of a swollen, red, fleshy part, technically called its belly, at either end of which is found a strong rope-like cord or sinew. If you will imagine such a muscle stretching between two bones separated from each other by a joint, the muscle attached to each bone by its rope or tendon, then you can easily understand that if this fleshy part shorten and contract, the two bones will be brought nearer each other, and a movement result. The muscles therefore possess as their leading characteristic the power of contraction.

I have here upon the table, in order to illustrate this point, a preparation consisting of one of the muscles from the limb of a frog. Attached at one end to a bone, which is firmly fixed in an iron stand, its opposite end is connected by a small thread with a simple apparatus very much like a railway danger-signal. If the thread be pulled on the signal will at once be elevated. If this muscle contract and shorten in its length, it will pull on the thread and move the signal. By stimulating this muscle with an electric current you see that such a movement is immediately produced. Conceive the signal to represent a second bone, and you will be able to get a fair idea of how such a muscle acts in the living body.

The framework of the machine which we are engaged in building up is literally clothed or invested with beef or flesh, the various muscles of which differ much in shape and size—*e.g.*, there are large muscles to move the limbs, smaller ones to act on the ribs, while those moving the eyeball are extremely small indeed. Muscles act in groups as well as singly, and all the more important and larger movements are executed by a number of muscles acting in concert.

When a muscle has ceased to contract, it immediately becomes relaxed, and assumes its normal condition of rest, ready at once, if called upon, for fresh exertion. After a lengthened period of work the muscles become tired and less able to

produce such perfect movements. The fatigue which we experience in our legs after an unusually long walk furnishes an everyday example of this fact. Nothing is so good for the muscular system as regular exercise, when kept within due bounds. An entire Health Lecture might be devoted to this one particular point—a point upon which too great stress cannot be laid, as not only does exercise vastly improve the condition and power of the muscles, but it contributes immensely to the general tone and well-being of the entire body.

Many of the movements of the body are independent of muscular action altogether, as when, for example, the arm is lifted from the side and then simply let fall, when it moves in obedience to the ordinary laws of gravitation, whenever the muscles which have raised it cease to act. The position of the lower jaw also affords a striking instance of this action of gravitation—our mouths remain closed only so long as we keep contracting the muscles raising the lower jaw—when we cease to do so the jaw drops and the mouth gapes. As is well known, when death removes the power of muscular action, one of its earliest signs is this same dropping of the jaw. You may remember that in order to make this little frog's muscle contract I had to employ an electric current. So in the living body, before a muscle can contract, before a movement can be effected, a stimulus must be brought to act upon the muscle, and this stimulus is provided by the Nervous System.

The nervous system is exceedingly intricate, and may most conveniently be compared to a telegraphic apparatus. We have accordingly great batteries stored with nervous force provided in the Brain and Spinal Cord—complex organs which, as I have already mentioned, are situated in the cavities of the skull and vertebral column, whose bony formation affords admirably the protection which organs so vital necessarily require. In these organs numerous groups of peculiar little bodies called nerve-cells exist, in which the nerve force is generated and stored up. Connected with these, and laid down through every part of the body, is an intricate system of cords, which we know as the nerves, and which act very much like ordinary telegraphic wires, viz., they convey messages. Each nerve consists of many wires as it were, lying in the same bundle and closely connected together.

In a transatlantic cable there exist several wires, each capable of transmitting a message. Along one wire a message may be travelling to America, while along another a message may be on its way home, and this at the same time. The passage of the one does not, however, retard or interfere with that of the other, owing to the fact that each wire is coated by what is called an insulating substance (*e.g.*, india-rubber), which confines each electric current to its own proper wire, and at the same time prevents any of its force from being dissipated in the ocean. Lastly, around the cable is a strong external covering, designed to protect the bundle of insulated wires which lie within it. Our nerves resemble most closely in construction that of such a cable. Each is protected by a strong fibrous sheath, within which lie the nerve fibres insulated from each other, and capable of transmitting messages, some from the brain, others to the brain.

When I wish to bend my elbow, a message is flashed from the brain along nerve fibres to the muscles acting upon that joint; and by the contraction of these muscles the movement required is at once produced. Such nerve fibres end in the substance of the muscles, and by conveying the message or stimulus from the brain into their substance, induce contraction. Other nerve fibres convey impressions from the skin and other parts to the brain; but of these more anon.

Our Human Machine is now one capable of movement; but in order that this may be carried on, we must provide its various parts with nourishment or fuel.

This nourishment is provided by the blood, a fluid which not only contains nutritious matter, but also a stimulus in the form of a gas, viz., Oxygen. In order that this fluid may be supplied to every part and every tissue of the body, an elaborate system of pipes is laid down, these being connected with a great force-pump, "the Heart." The blood is pumped by this wonderful hollow muscle along supply-pipes or arteries, which become smaller and smaller the further they extend, until it reaches a series of minute tubes called capillaries. Through these it can only pass very slowly, on account of their size. The capillaries are tubes whose walls are of great thinness and delicacy, and it is while passing through them at a high pressure that the blood yields through their walls

nutritious matter and oxygen to the various tissues, bones, joints, muscles, nerves, &c. The blood is then returned to the heart by a third series of pipes called veins.

It is easy to understand that even although the body be provided with this perfect blood-vascular system, that necessarily the blood will soon have its nutritive and stimulant powers impaired by the constant demand made upon these by the tissues, and will, moreover, become speedily impure by various effete products, which in its passage it removes from these structures. In order, therefore, to maintain the blood healthy and active, it must be provided with fresh nutritive matter and fresh Oxygen, as well as with a means whereby its effete and poisonous matters can be constantly removed. The time at my disposal forbids me to do more than merely mention the wonderful mechanisms by which these results are effected.

The nutritious matter is formed by, and introduced into the blood, from the Alimentary System. This consists of the mouth, gullet, stomach, and intestine or gut. The mouth is provided with teeth, by which, in chewing, we tear and grind the food introduced into it. This action is much aided by the movements of the tongue, while from organs called glands, saliva is poured out upon the mass, which, after due mastication, is soft, moist, and pulpy, and being swallowed, passes down the gullet into the stomach, in which hollow bag it remains for about a couple of hours. The stomach not only provides it with a large quantity of juice, called gastric juice, but by its movements churns it into a thick gruel-like fluid, which passes slowly down the long intestinal tube. During its passage, it is acted upon by various juices poured upon it from the liver, the pancreas or sweat-bread, and other secreting structures; while at the same time the bulk of its nourishing material is removed partly by the blood capillaries, which ramify thickly everywhere along the canal, and partly by a delicate series of tubes called Lymphatics. These lymphatics carry this nourishing matter and ultimately pour it into the veins. The unused and effete matter is ultimately voided.

In this way, therefore, the blood is ever receiving a fresh store of nutritious material.

In speaking of the blood, I mentioned that it possessed not only nourishing matter, but also a stimulus in the form of a gas, viz.,

Oxygen. I have shown you how nourishing matter is provided. I will now endeavour to explain whence it derives its oxygen. It is by means of the Respiratory System. This consists of the Lungs, a pair of great bellows situated in the chest, into which the air is introduced by the trachea or windpipe. These bellows move some twelve to sixteen times per minute, and by their action, air containing a considerable percentage of oxygen, is brought into close contact with the blood.

Let us glance for a moment at the structure of a lung. On following a large air-tube or bronchus into its substance, it is found to branch extensively as it proceeds, until its branches become very fine in calibre. Each little tube ultimately ends in air sacs. These little rounded spaces exist in clusters, and possess exceedingly delicate walls, on whose outer surface ramifies a dense network of very minute blood capillaries. In alluding previously to capillaries, I specially mentioned the thinness of their walls.

The blood in these is therefore separated from the air in the air sacs by two very fine membranes—the one belonging to the sac and forming its wall, the other the wall of the vessel. The venous or impure blood—blood which has in its course given up its oxygen to the tissues, and which has become charged thereby with an extra amount of the poisonous carbonic acid—flows through these lung capillaries.

It would occupy more time than we have at our disposal to describe what is meant by "diffusion of gases;" but let me tell you that the oxygen from the air contained in the air sac passes through these wall membranes into the blood, while the carbonic acid is diffused in turn from the blood into the air-cell, from which it is eventually removed through the bronchi or air-tubes and windpipe into the external atmosphere.

I need scarcely say that this power which these gases possess of diffusing through these membranes does not in any way alter the position of the blood, which remains confined to its vessels during the entire process. By means of this double interchange of gases, therefore, the blood is provided with fresh oxygen, while its excess of carbonic acid is removed. When we breathe, therefore, we not only inhale fresh oxygen, but we exhale carbonic acid and certain putrescible matters.

The change in the appearance of the blood after it has passed

through the lungs is very striking—of a dark purplish colour before, it becomes bright scarlet after its passage. From the lungs this fresh, active blood is returned to the heart, and from thence it is driven to the tissues once again.

The Kidneys are the great organs by which most of the effete and deleterious matters are constantly being removed from the blood, and aided in this function to some extent by the skin and lungs. By all three, however, something more than effete material is excreted or removed, and that is water. Water constitutes the main bulk of the urine, the perspiration, and is also exhaled as a fine vapour from the lungs, as may be readily demonstrated by breathing on some cold surface, *e.g.*, a mirror, upon which it is speedily condensed. This water is entirely derived from the blood, which, therefore, would soon become concentrated, were it not that we drink fluids many times daily, which pass into the blood and preserve it in a proper state of dilution.

By these means, then, the blood is maintained at a pretty constant strength.

The vital changes occurring in the tissues of the human body generate an immense amount of heat, the surplus of which is, however, lost by the skin, and to a less extent by the organs of respiration and excretion already described; and so a uniform body temperature is maintained.

The skin or external covering of the body is, in itself, a wonderful structure—soft, yielding, and elastic, yet strong and tough, it is admirably suited for purposes of protection. It is kept moist by the constant exudation upon its surface of the so-called insensible perspiration, while it is richly provided with little glandular bodies, which supply it with an oily substance, by which it is prevented from drying and cracking. Hair and nail are mere modifications of skin.

Everywhere under the skin lies a coating of fat, which, by its presence, retards the too speedy dissipation of heat, and also by its filling up hollows and covering bony parts, gives the contour of the body a more rounded and graceful appearance.

We have up to this point constructed the Human Machine, endowed it with movements, and furnished it with the apparatus necessary for the carrying on of these; it has still, however, to be provided with properties by means of which it can appreciate and

move amid its external surroundings. These properties exist in the senses. Popularly speaking, the senses are five in number—Touch, Sight, Hearing, Smell, and Taste.

In order that you may easily understand how these senses act, I must carry you back to the nervous system for a few moments. You will remember that in describing the numerous cords or nerves which run through the various parts of the body, I showed you that some nerve fibres conveyed messages from the brain to muscles, while others conducted messages from the skin and other parts to the brain. A nerve of the latter class is known as a sensory nerve. The minute terminations of such nerves are found everywhere in the skin, as an eminent physiologist has said, "The skin is a sensory organ which encloses our entire body, and is adapted to render every part of the surface of our body sensible of external impressions, and, indeed, of impressions of manifold kinds, which arouse in us peculiar sensations, and are inseparably connected with mental processes."

When an external object touches any part of the skin of our body, the minute nerve terminations there are stimulated, a message or impulse is conveyed along a sensory nerve to the brain, and by a mental process there we perceive that we have touched something. The sense of touch is more sensitive in some parts than others—*e.g.*, the skin of palms, fingers, and sole is much more sensitive than that of the arms or back. When sensory nerves are destroyed by accident or disease, the skin of the region supplied by these loses, of course, its sense of touch. The skin, in addition to the sense of touch, supplies us with a sense of pressure as well as of temperature, but I will not occupy any time with a description of these. Let me, however, state that by means of the sense of touch we can not only feel objects, but can fairly estimate their size and shape. There can be no doubt that this sense is much more perfectly developed in some individuals than others, and we all know how much education can improve it, as, for example, in the case of a blind person. Pain is also perceived by means of these sensory nerves.

Sight is afforded us by means of the Eyes.

The eyeballs are delicate organs, and are situated in little bony cavities in the skull. They are thus in close proximity to the brain, while at the same time they are admirably protected. In

the orbit each eyeball lies embedded in fat; it has special muscles to move it, and vessels and nerves to supply it. It is connected with the brain behind by the large nerve of sight.

The anatomy of the organ of sight is most intricate and complex. To describe it with anything like completeness one would require to enter into the physical properties of light before even attempting to discuss its structure and functions. These have, however, been fully gone into in a past Health Lecture, so that I will merely in a few words give you some faint idea of how it is that we see.

The eyeball is, perhaps, most simply understood by comparing it with a photographic camera.

The camera which I now show you consists of a box or case, the interior of which is blackened; of a lens by which near or distant objects can be focussed; of little plates or diaphragms pierced with holes of various sizes, by means of which the amount of light admitted to the lens can be regulated; of a cap or curtain, by which the light can be shut off; and lastly, of a sensitive plate, upon which the impression of a portrait or object view is received.

In the human eye there are structures practically identical in function with the various parts of the camera. There is to represent the box a strong protecting covering, whose interior is blackened. There is a lens with focussing apparatus, an aperture or pupil through which the light passes, an aperture capable of being altered in size by a movable diaphragm called the iris. The sensitive plate is represented by a delicate nervous membrane known as the retina. Lastly, the eyelids form the cap or curtain of our human camera. When a photographer wishes to take a portrait or picture of an object he first focuses it carefully, so as to give it its greatest distinctness, and then he exposes at that focus his sensitive plate for a few seconds, when an impression of the object is photographed upon the plate. He must, however, introduce a fresh plate before he can take a second picture.

When we look at an object we first insensibly focus it, a picture or image of it is formed on the retina, from thence a stimulus passes along the nerve of sight to the brain, and by a mental process there we perceive the object looked at. No sooner, however, do we remove our eyes from that object than

the retina or sensitive plate is, as it were, freshened or cleaned, and instantly we can look at another object and take a fresh photograph.

The sense of Hearing is provided by the Ear.

This consists of a passage leading to the drum, a membrane tightly stretched across its inner end. This drum is connected by a delicate chain of little bones with an elaborate mechanism called the internal ear. The latter consists of a convoluted organ embedded in bone just below the under surface of the brain. Its interior is filled with fluid, in which lie the minute nerve-endings of the nerve of hearing, which passes from thence to the brain. In order that the membrane of an ordinary drum may vibrate freely, it is necessary that air be present upon both sides of it. This is exactly the case in the human drum, for a small tube from the back of the throat admits air to the inner surface of the membrane. A sound by a series of waves passes along the outer passages and strikes the drum, whose membrane thrown into vibrations, moves the chain of bones, which movement is communicated to the fluid of the internal ear, the nerve-endings there are stimulated, an impression or impulse is sent along the nerve of hearing to the brain, and by mental processes there, we are conscious of a sound and its characters. The "so-called ear" or auricle has little to do with hearing beyond serving as a mere horn or ear-trumpet.

The sense of Smell is provided by the Nose, whose cavity is lined by a soft delicate membrane, in which lie embedded the minute nerve-endings of the nerve of smell, which are, of course, connected with the brain. When we sniff into our nostrils some perfume, such as musk, the odiferous particles stimulate the nerve-endings, impulses are sent to the brain, and we experience the sensation of smell.

Taste is furnished by the Tongue, whose upper surface is studded all over with little eminences called Papillae, some of which possess nerve-endings connected with the nerves of taste, which are connected with the brain. When a soluble substance comes in contact with these latter papillae, the message is flashed to the brain, and just as in the other special senses, sets up a mental action there, whereby we perceive the taste of the substance.

The Human Machine which we have thus constructed is capable

of appreciating and moving amidst its surroundings. It can move, touch, see, hear, smell, and taste. In addition, however, it must possess the power of expressing its thoughts. This it does by means of the Voice. Connected with the windpipe, which has been previously alluded to as the great pipe supplying the lungs or bellows of the machine with air, there is situated in the upper part of the neck a musical instrument called the Larynx. The larynx is a little box constructed of small pieces of cartilage, jointed on to each other, and across this box are stretched two elastic membranes, called the vocal cords. These cords can be tightened or loosened, brought very close to each other, or separated widely from one another by the action of various muscles proper to the larynx. In breathing, all the air passes through between these two cords, which are then comparatively lax and widely separate. But when we wish to employ our voice, the air from the lungs is driven against the cords in a series of puffs, the cords, of course, being first brought into position and made properly tense, when they are thrown into vibrations, and sound is produced. The note sounded varies, of course, according to the tension and position of the cords. In order to articulate, this sound, in its passage through the mouth, must be modified by the tongue, palate, lips, and teeth before we can form letters and words.

In speaking of the various systems of the body, I have referred to the brain as though it were a great telegraphic office, constantly receiving and sending out messages.

Let me, however, tell you that the brain has other and most important functions. For in it many subtle processes are ever being carried on, processes whose workings are hard to unravel and understand, processes by which we think, reason, and remember. Of these, however, I have no time to speak—in fact, the brief space of one lecture has prevented me from giving more than a most elementary account of the construction of the wondrous Human Machine ; but I sincerely trust that even this rapid and imperfect review of its principal points may have at least interested you.

The Human Machine, so exquisitely perfect in its construction, would, however, be but a passive structure, were it not for that indefinable and mysterious motor power, which we know as life, the consideration of which must be left to physiologists to grapple with.

The machine which I have described resembles in the closest possible manner the mechanism found in the higher animal world generally, in which the various systems are practically identical with those of man. The difference between man and the lower animals is, in fact, not one of quality, but of degree.

This latter fact is the chief basis upon which the great doctrine of Evolution rests, a doctrine which holds that man is a mere progressive improvement on the brute creation. It is not within the scope of this lecture to attempt to discuss Evolution. Those among us who are timid and fearful on the subject, may, perhaps, be able to take comfort to themselves from the words of a celebrated University Professor, "What matters it though an ape be your grandfather, a man's a man for a' that."

We have considered man as a mere animal, a mere living machine, but he possesses God-like qualities, both in nature and character, which not only crown him as king of the animal world, but most sharply mark him off from his natural subjects. The great gulf which separates him from the lower animals is the reasoning faculty in conjunction with the moral and religious feelings.

As an eminent scientist has quite recently said : "Man has a great history and a future life beyond the grave. His mortal nature is one thing, his immortal another, and the origin of his body cannot determine the hereafter of his soul. He is an animal, even in his present state, distinguished from all other animals by the development of his moral faculties, by his knowledge of good and evil—of the law of right and wrong, &c., &c. It is, however, vain to deny that such high attributes belong to a being who in structure and function has so close an affinity to the brutes."

Lastly, although man be king of the animal creation, he is himself the subject of a higher power.

"Bound on a voyage of awful length,
And dangers little known,
A stranger to superior strength,
Man vainly trusts his own.

But oars alone can ne'er prevail
To reach the distant coast,
The breath of Heaven must swell the sail,
Or all the toil is lost."

MILK AND MILK SUPPLY.

By G. SIMS WOODHEAD, M.D.

MILK AND MILK SUPPLY.

By G. SIMS WOODHEAD, M.D., F.R.C.P.E., F.R.S.E.

Milk, the naturally prepared food of the young of the mammalian or suckling animals, is a material with which we are so familiar, that it would appear at first sight as though to say anything about it nowadays could only be compared to "slaying the thrice slain," or doing something else equally superfluous or ridiculous. Milk is a fluid delivered every morning, and, perhaps, evening, by the milkman; it is an opalescent fluid, and probably is good for children, because we always give it to Baby, and Baby appears to require nothing else. There may be a scare for a few months about scarlatina spread by milk, and then, again, another about consumption scattered broadcast by a similar agency, but we all go on taking it, and often, I am afraid, think very little of the means by which we might improve either the milk or the milk supply.

To-night I shall attempt to place before you, as concisely as possible, some facts about milk and about milk supply that may be of use to those who take an interest in the welfare of the community, and that may be not uninteresting even to those who come to be entertained.

Milk is a somewhat complex fluid consisting of water, caseine, albumen, fat, milk-sugar, and salts or inorganic material. It contains, therefore, all the elements necessary for the building up of the animal organism. The water supplying moisture, the caseine and albumen the nitrogenous elements, and the butter and sugar supplying fat, the salts filling in the inorganic material required; potash salts (found especially in blood and muscle), phosphates of lime and magnesia (necessary for the

formation of bone), and other salts in smaller proportion are all found in milk.

	Human.		Cow.	Goat.	Ass.
Water,	87·24 to 90·58		86·23	86·85	89·01
Solids,	9.42 to 12·39		13·77	13·52	10·99
Caseine,	2·91 to 3·92	1·90 to 2·36	3·23	2·53	3·57
Albumen,	... ...		0.50	1·26	
Butter,	2·67 to 4·30		4·50	4·34	1·85
Milk-sugar,	3.15 to 6·09		4·93	3·78	5·05
Salts,	0·14 to 0·28		0·61	0·65	

Milk, then, may be looked upon as a very fine emulsion of fat in a solution of caseine, milk-sugar, and extractives, in water. If we examine it under the microscope, we find that all we can see in a certain focal plane is an enormous number of minute globules, each with a dark outline, the centre being then, as a rule, bright, and strongly refractile. These small globules vary in size, from 0·0009 mm. to 0·009 mm. in fresh cows' milk, and it has been calculated that there are from 2·6 millions to 11·4 millions of these globules, of various sizes, in each cubic mm. of such milk. Although they seem to be simple enough, there has been considerable controversy as to the structure of these globules. By some, in fact by the majority of those who have studied the subject, it is held that each is surrounded by a delicate capsule or wall of caseine or allied nitrogenous material. In proof of this, they allege that by careful preparation of milk with logwood solution or osmic acid, they are able to stain this capsule, and bring it so into prominence, that it may be seen under the microscope as a distinct membrane. Other observers, and most competent observers too, declare that we are dealing with a fluid in which fat is merely suspended under all the conditions and obeying all the laws of emulsification. By these it is contended that the fat globules are merely fat globules, and nothing more; that they have no caseine capsule, that they are suspended in a fluid in which caseine and other matters are held in solution, and that they are kept from running together simply by ordinary physical laws. When such eminent authorities disagree, it becomes a difficult matter to decide, and as it is not essential for our present purposes, I propose that we should leave them to fight the matter out.

Let us now see what is the source of this milk, and how it is secreted from or by the milk gland. If we examine such a gland during its quiescent condition, we find that it is a somewhat complex structure. We have a number of minute vesicles or chambers, each lined by a layer of small, square or slightly flattened cells. Each of these cells, in turn, is composed of a granular, white-of-egg-looking material, with a bright spot, the nucleus, in the centre. Note that there is only one bright spot. These little cells form a kind of pavement, which rests on a delicate, homogenous, or glassy-looking membrane. Outside this membrane is a most complicated series of blood-vessels and juice channels, supported by a delicate network of what is known as connective tissue. These small chambers are grouped together, and are so arranged that small ducts leading from them unite to form larger ducts, and so on until they come to the surface, where the milk is set free. So long as the gland remains quiescent these lining cells forming the pavement remain unaltered. As soon, however, as the demand for milk is made, considerable alterations are at once brought about—the square cells become larger and taller, they are now called cylindrical instead of cubical cells, the clear, bright points in the centre multiply, and there may be two or even three of them in a single cell. In consequence of the increase in size there is now a larger proportion of the albuminous part of the cell, and this albuminous material is distinctly more granular than in the quiescent cell. Near the upper part of the cell this is especially the case, and, very soon, small fat globules make their appearance in this portion; these, which are the milk globules, are gradually set free into the chamber. We may sometimes find that a portion of the granular cell material remains adherent to the milk or fat globule.

At the same time that we have all this going on in the cells themselves, there are other changes taking place in the tissues around or outside the homogenous membrane. The blood-vessels become greatly enlarged, and the spaces in the connective tissue network become distended. From these distended vessels and spaces a large quantity of fluid, carrying with it a portion of the constituents of the blood, is passed on through the membrane to these active cells. The cells take up what they require to produce fat, milk-sugar, and serum albumen, the latter of which, by a process of fermentation, is converted into caseine or milk-albumen.

All the constituent parts of milk are derived from the blood, either directly or through the agency of the protoplasm of these little cells, which feed on the fluids offered to them through the channels already mentioned, digest the materials so presented to them, and turn them out in the form of milk.

It must be remembered that there is no sudden transition from the flat cell to the large cylindrical cell with the fat globule at its apex. Immediately after the birth of the calf it will be found that some of the cells in the milk gland of the mother cow have undergone a kind of fatty degeneration and are completely filled with small round fat globules. These are the superficial cells which appear to have been some time in arriving at this stage. Soon these disappear and the regular milk formation sets in. We have already mentioned that the caseine is a derivative of the serum albumen; the sugar and fat are also probably derived from the same source. Now, where the milk formation has not set in completely, as during the above intermediate stage, it will be found that the amount of caseine is comparatively small, but there is an excess of other albumens. The process of conversion in the secretion is not going on so perfectly, consequently anything which in ordinary circumstances would affect the character of the milk would be much more likely to affect both milk and calf at this stage than at any other. The bearing of this we shall see immediately. It may be asked why such stress is always laid upon the presence of caseine in milk. There are two reasons: it is not very easily digested in anything but small quantities, especially by young children; but, to counterbalance this, we have the second reason, it is said to contain more loosely combined nitrogen than any other of the animal albumens. We should therefore assume that the presence of too great a proportion of these other serum albumens and a diminution of the amount of caseine indicates that the milk is not of first-class quality. If we inquire into the conditions that regulate the conversion we shall find additional evidence of this.

The various constituents of milk are formed directly from the protoplasm of the cell or by it from the fluids and solids supplied to it. The caseine is formed from the albumen in the cell. In the case of acute fevers, or when active exercise is taken, there is

invariably an increase in the amount of caseine present in milk; whilst in cases of starvation, chronic wasting, and certain other diseases, there is an increase in the relative amount of albumen at the expense of the caseine. Milk exposed to the air for two or three days is found to absorb more than its own volume of oxygen, and if this takes place at the temperature of the body, there is certainly, at first, an increase of the caseine at the expense of the albumen, and then, very probably, by a process of oxidation, part of the caseine is transformed into fat. So that very slight changes in the food, health, or exercise of the animal may have very marked effect on the suitability of the milk as food for human beings, especially children.

In the case of fevers, we have said that the amount of caseine becomes increased, and it might therefore at the first blush be assumed that it should be well adapted for infants' food. This would be contrary to all our preconceived notions, and is certainly not the case, for, on more careful examination, it is found that although the actual quantity of milk secreted is less, there is, along with the increase of caseine, a diminution in the amount of sugar and fats, so that here, although the serum albumen is converted into caseine, the process continues no further, and we have a diminished production of the two important constituents of milk, sugar, and fat, the great fat formers for the young animal. If all these changes may occur in consequence of slight alterations in the food or in the state of the health of the milk-giving animal, how much more serious becomes the question when the use of drugs or the presence of grave diseases is involved. A patient, human or animal, is taking salts of iodine, antimony (as tartar emetic), or arsenic, mercury, iron, as tonics; or lead is being taken in drinking water; or opium, chloroform, alcohol, or ether, are being administered. The result is inevitably the same—the drug appears in the milk, and the calf or child fed on such milk is dosed, second-hand, as it were. Poisonous plants, fermented grain (draff), in which numerous volatile substances rapidly make their appearance, act equally injuriously on the young animal through the milk, and should therefore be avoided as food for milk-giving animals under any circumstances, but especially where the supply is intended for children.

It has now frequently been pointed out that in certain specific

infective conditions the micro-organisms characteristic of the disease have been found in the milk; the anthrax bacillus and some others are said to be found even when there is no local affection of the milk gland; and it is still an open question whether the tubercule bacillus may not also get into the milk without the gland being the seat of regular tubercle formation. That tubercle bacilli swarm in certain milks is now proved to demonstration, but in view of the facts above mentioned, it is not necessary to accept such proof. Even though there is not a single bacillus found in a thousand gallons of milk taken from tuberculous cattle, the milk of these cows is not fit food for the consumption of children. The general health of the cow is below par; it is suffering from a specific infective fever in consequence of which the constitution of the milk is altered, *i.e.*, secretion is not going on properly; and in addition to that, if there is any specific poison formed during the course of the disease, a portion of it is bound to be carried by the blood and lymph to the milk gland, whence it will find its way to the milk secreted, and thence to the child.

These dangers are simply mentioned, but it must be borne in mind that they are quite as real as if we devoted two or three hours to an elaborate description of them.

MILK FOR INFANTS.

On reference to the table already given it will be found that there are certain very marked differences in the composition of human and cows' milk. Cows' milk contains much more caseine and albumen than does the former, more fat, less sugar, and more salts and extractives. In other words, cows' milk is considerably the richer of the two, especially in the matter of nitrogenous material contained in the caseine albumen (or milk white of egg). Beyond this difference, however, we have others of equally great importance. Cows' milk, when tested, is usually found to be slightly acid, even when freshly milked, though it is contended that this acidity is due to the standing of the accumulated milk in the ducts of the milk gland. Human milk, on the other hand, is invariably alkaline. Cows' milk, when it coagulates or curds, forms a solid, heavy mass, a mass with which most of us are

familiar, but the human milk, coagulated or curdled, presents the curd in the form of small floculi, or light flakes.

If we are to assume that the food supplied for each animal to its young ones is that best suited to nourish them, we are at once driven to the conclusion that cows' milk in its natural form is not by any means a suitable food for a child. It is all very well for the calf to have its food partly acidulated before introduction into the acid fluids of its stomach, but a child cannot stand this; and whilst it is an easy matter for the ruminating calf to regurgitate and break up the hard curdy mass formed in the stomach, it is out of the question for the digestive apparatus of a young child to negotiate these hard masses.

In what way, in the event of there being an insufficient supply of the natural food supply for an infant, is a suitable nourishing food to be obtained? In the first place, there is too large a proportion of caseine or nitrogenous material present. The milk is too rich, and the absorbent and excretory organs would be too greatly taxed in the processes of nutrition and excretion. To get over this first difficulty is an easy enough matter. All that is necessary is to add a certain proportion of pure boiled water. In the case of new-born or very young children it is better to err on the side of over-dilution, and one-half or, still better, two-thirds may be added. So far so good. We refer to our table, and we find that, in consequence of this addition of water, we have brought down the percentage amount of caseine to a point even below that of the child's natural food, but in so doing we have altered the proportion of both milk fat and sugar, the percentage quantities of which are now far too low. In order to restore the balance it is usual, and certainly desirable, to add a certain amount of cream and a quantity of sugar. To follow out a perfect system, we should add milk-sugar, and where a child is delicate, or where the artificial food does not in the first instance agree with it, this should most certainly be done, but in most cases it will be found that ordinary cane sugar serves our purpose quite well. So far we have been able to correct the proportions of the constituent elements of the milk, but there are still the tendency to acidity and the massing of the curd to pay attention to. To correct the acidity, all that is necessary is to add a small quantity of lime water or milk of lime. This should never be done to

cover the taste of "sour" milk, or even in the case of milk that is not perfectly fresh; it is used merely to bring the cow's milk into a condition more like that of the normal food. Now as to the curd mass, it will be found that if the milk is curdled after the addition of the water, lime water, cream, and sugar, the curd does not form the same dense mass; a much more granular curd is the result, a curd much more readily attacked by the digestive fluids of the child.

Some people suggest that in order to keep the curd *small* a little corn flour or other starchy matter, which should be first thoroughly broken up by continuous boiling in water for two or three hours, should be added to the cow's milk. This prevents the massing of the coagulum, and renders the milk more digestible to the child. As doctors are by no means agreed on this point it may be well, however, to give a formula for artificial milk in which starch plays no part.

Pure milk, ...	one cupful.
Cream, ...	half a cupful.
Boiling water, ...	two cupfuls.
Lime water, ...	one tablespoonful.
Sugar (cane or milk), . .	one teaspoonful.

In summer it is well to boil the milk and then keep it in a refrigerator until required for use. Or, better still, it should be sterilised in small bottles corked with cotton wadding, each containing enough milk for a single meal. As the child grows older the proportion of milk may be gradually increased until almost pure milk is given, but we should never be in too great a hurry about this. Where there is any doubt about the purity of the ordinary milk, condensed milk and preserved cream may be used. In such cases make a mixture of one part condensed milk, ten parts of boiling water, mix thoroughly, and add to one pint of this mixture four tablespoonfuls of scalded cream and half a cupful of lime water, or a corresponding quantity of lactophosphate and carbonate of lime. This is especially necessary where there is any tendency to looseness of the bowels, or where sugar has to be added to the milk to bring its constituents to the normal proportions. Various methods of peptonising the milk are recommended by different authorities, but with these we have no time to deal this evening.

MILK AND DISEASE.

This typical example of a perfect food for the higher animals is no less valuable as a medium on which micro-organisms can thrive. It contains all the elements necessary for the building up of tissue, whether highly or lowly organised, and contains them in a form in which, as we have seen, they may be very easily utilised. From a comparison of the composition of micro-organisms (micro-organisms according to Nencki—water 84·81, albumen 13·027, fat 1·198, ash 0·638, extractives 0·327) with that of milk, we see how closely it supplies all their wants. Milk sugar supplies a large proportion of the carbon required for their growth. The nitrogen is, as we have seen, contained in the albumen, whilst the salts of potassium, iron, manganese, calcium, &c., are readily converted to the uses of micro-organisms of various forms. Milk then is an excellent nutrient medium for micro-organisms, and should they gain access to it, they have every opportunity of growing and multiplying. Certain of the more ordinary forms grow more rapidly than others and seize all, or most, of the pabulum, but, on the other hand, samples of milk placed in different places or allowed to stand under different conditions, when examined microscopically, will be found to contain different organisms, one or other predominating according to the source from which they are derived; according to the predominance of certain organisms we shall of course find special kinds of fermentation.

Of the fermentations in milk, the most common is the lactic acid fermentation, which, as Lister, in his beautiful and classical experiments, demonstrated most clearly, is associated with the growth of the Bacterium lactis.

In this process there is a rapid growth and proliferation of the minute organism, and as it grows and feeds upon the constituents of the milk, principally the milk sugar, it assimilates what it requires, and in the process lactic acid is set free. This acts on the caseine, first dissolving it, and, when the temperature is raised, coagulating it, when a curd is formed; so that the alkali albumen has been rendered coagulable by the action of the acid. It is at once evident that the influence of such an organism is very far reaching, and it may for our purposes be taken as a type of the process of fermentation.

It is here particularly necessary to note, as Lister pointed out, that milk which was not allowed to be taken to the dairy, very frequently underwent several forms of putrefaction and fermentation, but not the lactic. Hence he inferred that there was a constant growth of this organism in the dairy, where the pabulum was always present, and where the organism could live, and be handed on from milk to milk indefinitely. The Bacterium lactis has, in fact, become endemic in the dairies. Taking into account the certainty with which this organism finds its way into the milk, it may be anticipated that the micro-organisms of disease when present in, or near, a dairy, will, with equal certainty and rapidity, find their way into the milk pan and its contents.

A second common fermentation, that during which butyric acid is formed, is set up by a somewhat larger organism, the Bacillus butyricus. It cannot proceed simultaneously with the lactic fermentation, as the B. butyricus cannot grow in an acid fluid. Here we have an example of one micro-organism by its action preventing the growth of a second. This B. butyricus, however, possesses greater vitality than the B. lactis, and often makes its appearance in milk that has been boiled for a short time, and in which the B. lactis has been killed. It then, as it grows and multiplies, brings about a coagulation of the caseine, and at the same time partially digests it.

What I wish to argue from this is, that if organisms, having such distinct biological characteristics as those above mentioned, can multiply, in milk, is it not natural to suppose that pathogenic organisms can flourish equally well in such a splendid pabulum. As has been proved by actual experiment, milk, when properly sterilised, is an excellent medium in which to cultivate micro-organisms, and we have seen that certain organisms not associated with disease grow in it with great rapidity.

Amongst the most important of all the diseases in which milk has been said to be the medium of propagation are diphtheria, scarlet fever, typhoid fever, tubercle and anthrax. Numerous others will suggest themselves to those conversant with the subject and its literature, but we may take these as fairly typical examples. In each case one (or more) organism has been described, and in those of anthrax (and shall we say tubercle) it has been demonstrated that this organism is the actual cause of

the disease. Taking it for granted that bacteria or allied organisms are associated with those diseases in which they have not already been actually demonstrated to be the casual agents (and we have a large body of evidence in favour of the theory). The milk has in many instances been left, by a process of exclusion, as the only possible medium by which the disease or the disease germs could have been carried, either directly from the cow or from patients ill with the disease.

We have examples of this in the 1878 North London diphtheria epidemic, the Hendon and St Andrews outbreaks of scarlatina, and Dr Foulis' interesting cases of the same disease. Not long ago I myself was called to see some cattle the milk from which was suspected of being the cause of scarlet fever in a small village near Edinburgh. The chain of evidence as regards the spread of the fever by the milk appeared to be complete, and I thought that I was to have an opportunity of confirming Dr Klein's observations. When I came to examine the cattle, however, I was at fault, as they appeared to me to be perfectly healthy, the whole milk apparatus of the cow was perfectly sound, and the cattle were in splendid condition. The cause was evidently not to be sought here. On making inquiries I found that a nephew of the farmer had come over from Glasgow to recruit, as he was just recovering from an illness which commenced with sickness and sore throat, and during which he had noticed that there was redness of the skin. The young man had left home during the stage of desquamation, and was now infecting all the milk on the small farm at which he was staying. I have already mentioned that an outbreak of anthrax may be caused by the distribution of milk from cattle affected by this disease, and that MM. Chamberllent and Moussons (Compt. rend. xcvii., I., 142), have been able to demonstrate the presence of well developed bacilli in the milk itself. Tubercle again has recently been proved to be the result of infection by tubercle bacilli carried in milk.

To the possibility and even probability that pathogenic organisms grow in milk we have already referred. Could it be proved that such organisms do not grow in milk, the fact would still remain that they can remain in milk for some time without losing any of their virulence. Such being the case let us see by what channels the virus may make its way into the milk of the cow.

(*a*) Organisms of various kinds may appear in the milk as the result of a general infective disease in the cow, the organisms and their products being secreted by the glandular epithelium just as other effete material. Again (*b*) we have the more localised condition of tubercle of the udder, when the milk has been found to be swarming with tubercle bacilli. Such milk when injected under the skin of a rabbit has produced typical tubercular lesions, first locally and then generally. (*c*) Organisms make their appearance in milk as the result of some local superficial lesions of the teat or udder of the cow. We have abundant evidence of that brought out in the recent controversy on the subject of cow-pox, true, false, and all its varieties. (*d*) Then infection or infective material may be carried from the hands or person of the milker to the milk. It is a well-known fact that several of the diseases of the teats of the cow may be transmitted from animal to animal by means of the hands of the milker. In a similar manner Bang suggests that tubercle of the udder may in some instances be initiated by the transmission of the virus from the milker to the teat. If then from cow to cow and from milker to cow, how much more easily from the milker to the milk, especially where persons convalescing from an infectious disease are performing this office, or that of milk distributor. (*e*) It has frequently been pointed out that polluted water added to milk, or even used to wash out the vessels in which the milk is stored or transported, may be a source of infinite mischief. Most micro-organisms, whether pathogenic or non-pathogenic, which can exist in water will thrive luxuriantly in milk, and several outbreaks of typhoid have been traced to milk and water so mixed (whether intentionally or not). Here the whole cycle is only too evident. (*f*) The next mode of transmission by milk of such diseases as scarlet fever is by means of imperfectly cleansed vessels, the property of the householders amongst whom scarlet fever is rife. The milkman going from door to door receives a dish which may have been standing during the whole night in the room of a patient suffering from fever. It is hurriedly rinsed out when the milkman is heard, and is handed to him with the particles of dust (and anyone who has examined the dust from an ill-ventilated room knows what that means) adhering to it. The

man fills up his measure, and then fills the vessel he has received, but in the process a few drops are sure to pass back into the milk pail, with the result that some of the dust is carried on to the next houses at which the milk is to be delivered. This imperfect cleansing of utensils is now usually with the consumers of the milk, and it is only fair to state that in most of the dairies the most scrupulous regard to cleanliness is observed.

Of all animal foods, as Bang points out, milk is the only one which is not systematically cooked before it is ingested. Except under special circumstances, or when there is a fever scare, no one, at least, no ordinary individual, thinks of boiling the milk to be used by the family. Every other kind of animal food, in this country at all events, undergoes some sort of cooking, baking, boiling, stewing, or the like, but milk is partaken of just as it comes from the dairyman. During a fever scare there is usually some attempt made to heat the milk to boiling point, even though only for a second or two. Let anyone try the experiment of boiling milk over the fire; wait until it begins to rise, and then remove the pan, stir up the milk thoroughly for a second, and then plunge in a thermometer. He will find that the milk is several degrees below boiling point, the milk in the centre of the pan having remained much below boiling point, even when that in contact with the metal is boiling, or even burning. Any spores in this central portion cannot have been killed, even if those at the periphery have been destroyed. It requires a temperature of 100 C. continued for from twenty to forty minutes to render it sterile, *i.e.*, to kill the organisms found connected with the ordinary fermentative and putrefactive processes.

MILK TESTING.

In consequence of the difference in the specific gravity of the various solid substances entering into the composition of milk (fat has a comparatively low specific gravity, from 0·996 to 0·936, but all the other solids are much higher), good milk, with all its fat in it, has a specific gravity of 1·028 to 1·034. If to this fluid with its high specific gravity we add either water or cream, we shall reduce the specific gravity in both cases, but with very different results. If by adding fat we can lower the specific gravity, we can, by taking away some of the fat, raise it in equal propor-

tion, so that in this case we can actually lower the specific gravity by increasing the amount of solids and the richness of the milk.

Analysts point out how milkmen used to trick the inspectors who depended upon the lactometer or specific gravity indicator for their analysis. It was a very ingenious trick, and if the ingenuity had been brought into play in doing honest work its author might have made a fortune.

First, the relative proportion of cream is diminished by simply adding skimmed milk, which has a high specific gravity, to the fresh milk; this, of course, raises the specific gravity. Now, by the simple expedient of adding a quantity of pure or impure water, as the circumstances of the case will allow, the specific gravity of the milk is brought down to the normal, and the inspector is duped. What renders the trick still more successful is the fact that the milk so watered gives up its cream much more readily and perfectly than even pure milk, especially if the water added be slightly warmed beforehand.

Then, too, as the addition of organic matter to water has to be very great to get a rise of specific gravity, a very slight error in reading will give a very great error in the estimation of the amount of solids, and it is therefore a matter of the greatest importance that correction for temperature should always be made. This, of course, may be done once for all and tabulated, but the composition of the milk varies so much, that definite and accurate results can never be obtained. Taken along with the following process however, the determination of the specific gravity of milk, if carried out carefully, is of considerable value. If a few drops of milk are put into a large quantity of water, it is found that according to the quantity of milk and the thickness of the layer of water, a certain opacity is obtained. If this mixture is put between two flat glass plates, behind which a light is held, by diminishing the thickness of the layer of milk and water, or by adding a little more water, the outlines of a flame which at first cannot be distinguished are gradually brought into view. Or again, if the mixture be put in a glass vessel with a flat bottom, and the vessel placed on a piece of paper on which there is printed matter, there comes a point at which the print is just readable. Add more milk and the print is just obscured; add more water and it is perfectly legible.

Vogel's and Doune's lactoscopes are both on this plan, but I

will describe one that is most admirably suited to ordinary everyday work. It is based on the same fundamental principles as the others, but is practically more useful than either. In making our calculations it must always be remembered that the turbidity of the milk serum, quite apart from the presence of fat globules, will cause some variation in the results, but a very large number of experiments carried out by different observers have practically settled the question, that by taking an average, a fair approximation may be obtained.

Panum's method, as I saw it carried out at the Milk Supply Association in Denmark, is the following :—Into a measured and marked 100 c.c. flask, pour about 90 c.c. of clean water; to this add with a pipette 5 c.c. of the milk to be tested; carefully fill up with water from a burette to 100 c.c.; shake thoroughly, and pass some of this mixture through the burette to wash out the water, and then fill up to the top to get rid of bubbles, and draw off down to 0 c.c. Now take a four-sided vessel made of glass plates held together by zinc angle plates. This vessel is 10 cm. × 10 cm. × 15 cm. Measure into this 500 c.c. of clean water, which thus forms a layer 5 cm. in thickness at the bottom of the vessel. Under this glass vessel put a piece of ordinary printed newspaper. Now gradually draw off the mixture of milk and water from the burette, stirring from time to time, until the print becomes just illegible. By a calculation based on a series of analyses, it is found that cream contains from 25 down to 12 or 13 per cent. of fat, and that in these cases the number of c.c. of cream mixture required to obscure the print is from 3 to 5·5 or 5·7.

Sweet milk contains from about 10 to 6 per cent. of fat, the number of c.c. required to hide the print in this instance being from about 6 down to 9. Anything below this is skim milk.

In making these calculations it must be remembered that the drops of fat held in suspension in milk vary very considerably in size, and that small drops absorb the light much more readily, or refract it much more strongly, than a similar weight of fat in large globules. We must remember, too, that when milk is allowed to stand, it is the fat in the form of large globules that first rises, and therefore the cream, though containing a large amount of fat, does not cause opacity in the same proportion that the same amount of fat in skimmed milk does; whilst in sweet

milk, in which we have a mixture of the two, we have again to calculate out on a different basis. As some of you may wish to perform this experiment as a matter of curiosity, I may give you the data on which to work, as calculated by Dr Bohr, Professor of Physiology in the University of Copenhagen. To obtain his formula he first estimated the opacity of a given sample of milk or cream, and then by means of extraction by æther, he obtained the fat in a form in which it could be weighed. He then compared the two; taking a number of samples, first of cream, then of sweet milk, and then of skimmed milk, he arrived at the following results. In all his experiments he found that by multiplying the number of c.c. required to obscure the print by the number representing the weighed percentage of fat, that he got from cream a maximum of 86·7, and a minimum of 70·4, or or an average, on eleven experiments, of 78·9. Taking this average as a fixed number for cream, he calculated that in any average specimen of cream, if you take the number of c.c. of the opacity point and divide this fixed number (78·9) by it, it gives you the amount of fat in the cream. Take for example a cream which gives you an opaque point (*i.e.*, it just obscures the print) at 3·6 c.c. Divide 78·9 by 3·6, and it gives you the amount of fat in the cream as 21·9. This is not absolutely accurate, but it is certainly within 2 per cent.

In the case of sweet milk this constant number is 57·8 because of the mixture of large and small globules of fat, and in skimmed milk it is 33·8, because of the number of small globules of which the fat consists. That is, as the opaque point reading rises, the relative proportion of fat contained diminishes more rapidly than in an inverse ratio. Thus, whilst with opaque point reading of 3 c.c. we have 26·3 per cent. of fat, with 14 c.c. we have only 4·1 per cent. of fat, and with 24 we have only 1.4 per cent.

Skim milk absorbs more light than diluted sweet milk containing the same quantity of fat as 1·0 to 0·268. This is an important point, and deserves to have some attention paid to it, although it is somewhat out of place to go into it more in detail at present. I have thought it well, however, to point out some of the difficulties met with in milk analysis, and to indicate that it is only within recent years that any organised attempt has been made to overcome them.

MILK SUPPLY.

Some little time ago, whilst engaged in the study of the relation of milk supply to the spread of certain infective diseases, my attention was called to a small pamphlet written by Dr Borch of Copenhagen, and translated into English and annotated by Mr A. Stewart MacGregor, the British Vice-Consul of that city. I was so deeply impressed with what I then read, that I determined, as I had to go to Copenhagen to study the subject of tuberculosis, to seize the opportunity of examining into the system adopted by the now famous Copenhagen Milk Supply Association. I was specially fortunate in being able to go directly to head-quarters, as I had an introduction to Mr G. Busck, the originator of the whole scheme, who with Mr Carl Sorenson, an old Lorettonian, and Mr Stewart MacGregor, supplied me with the most precise and full information that I could require. In 1878, Mr Busck was struck by the fact that his workmen were unable to procure milk except through their spirit dealer, and that where the head of the family did not drink spirits, the answer for a request for milk was, "Give him my compliments, and tell him if he does not buy my spirits I cannot sell him my milk." We have got beyond that in this country. In thinking over the matter, Mr Busck was struck by the fact that there was absolutely no control over the cattle, the farm labourers, adulteration, or contamination. He saw at once that here was a splendid opening and an opportunity for supplying a real necessity. "By providing the capital with milk, a good paying agricultural industrial business might be founded, and besides, and this was more important, the greater part of the inhabitants, and especially the children, for whom milk is indispensable, could be furnished with a produce of a much better quality than that bought at the distilleries or from the milkman; above all, it would be the produce of cows that were healthy and well kept: thus the health of those who used it would not be threatened by hidden dangers." The Copenhagen Milk Supply Association was the outcome of these cogitations.

It is interesting to learn how readily this scheme was taken up by those who were interested in the obtaining of pure milk. Professor Panum, the eminent physiologist, at once gave his support. Dr Borch and Herr Bille and other well-known medical

and philanthropic men soon showed in what light they viewed the working of this company, by giving their entire concurrence to both the principles and working details of the plan, of which I may give a short sketch.

Beginning at the beginning, we find that every cow on the farms that supply milk to the Association is subjected to a fortnightly inspection. This inspection is most thorough and searching; I went down to the country to see how it was carried on, and I was well satisfied that it was not a sham. Every animal, both in the cow-houses and in the fields, was carefully examined; notes were made, and these were compared with a similar record made at the last and previous inspections; certain cows were again allowed to come into the milk supply number and certain others were put out. This goes on every fortnight, and there is kept a regular staff of veterinary surgeons, whose duty it is to report on the health of the cattle on the different farms. Particular attention is paid to the examination, at short intervals, for tuberculosis, as it is believed that the development of tuberculosis of the udder is in certain cases so rapid that an early diagnosis of tubercular disease in any situation is imperative in order to avoid the great danger that would arise from mixing with sound milk the milk of cows so affected.

In order further to ensure the purity of the source, the Company appeal to the pockets of their farmers, and the way in which they deal with them affords an admirable example of the plan on which they work. They sent out a pledge, of which the following is a copy, to be signed by the contractors :—" I, the undersigned contractor to the Copenhagen Milk Supply Company, pledge myself herewith, to the best of my ability, to inquire into every case of infectious disease occurring either upon my farm or among the people employed in working for me, and to report every case of the above kind immediately to the Company." In return the Company bind themselves as follows :—" The highest price in the market will be paid for the milk from such farms as usual, if the notice is given in time to prevent any of it from being sold." In consequence of all these precautions there is guarantee that the stock at anyrate is healthy. Beyond this, however, the Company insists that certain regulations as to cleanliness, quality of feeding, and general treatment of the cows shall be observed

by the stock owners. The veterinary surgeon can do much in the way of reporting on the condition and quality of the food, on the state of cleanliness of cows and cowhouses, and on the diseases from which the animals are suffering. He can specify which animals supply milk for general and which for special purposes, and he can state how much milk is yielded by the cows which are ill and separted from the others, and the use made of it, but he can only visit at regular intervals, and he cannot control the working of the farm when he is not present. To assist him in this work, an inspector from time to time pays visits to the various farms to examine the management, the cooling down of the milk—in summer a very important item—and to see that cleanliness is observed during milking. In this he is assisted by an experienced dairymaid, who pays sudden and irregular visits to the various supply farms.

By the rules of the Company, the farmers are bound to cool the milk, immediately after milking, down to 41° F., so that it may arrive in good condition in Copenhagen, where the temperature of the milk must not be more than 50° F. at the time a sample is taken, immediately on the arrival of the milk.

"To provide for this," says one of the regulations, "the average productions of the cows at each farm (as shown by the usual fortnightly trial milkings) must be calculated, and 30 lbs. of ice (making due allowance for waste) must be kept in stock for every eleven gallons of milk produced." The milk has to be sent off so that it may just catch the train, and it is never allowed to stand in the sun, either in the station or in the train. In all this, however, much has to be left to the honour of the contractor; in most instances the system works well, more especially as there is every inducement offered to keep faith with the Company.

The following additional regulations are also most rigorously enforced by the officers of the Association:—

"The milk of cows newly calved must not be supplied until twelve days after calving." The importance of insisting on this has already been mentioned. "The food of the cows must be such that the milk has no disagreeable taste from it. Swedish and other turnips must not be used at all, nor, in the autumn, turnip leaves. Carrots and mangolds may be used, but at most

half a bushel per cow to at least 7 lbs. of corn. One and a half lbs. of rape cake to at least 5 lbs. of oats and barley, exclusive of hay, may also be given."

"Brewers' grain and similar refuse from distilleries are strictly forbidden, as is also every kind of fodder which is not fresh and in good condition." The proportions in which the different kinds of food are to be given must be arranged with the Company before the contractor commences to supply the milk.

"In summer, stall-feeding will not, under any circumstances, be permitted. The cows must be fed in the open air, and upon clover and grass. Should green oats and vetches be given while the animals are fed upon this description of food, the milk will not be received by the Company. The contractors must be willing, on word of honour, to reply to all inquiries made by the Company on this or other subjects, and to report at once any deviation from the rules imposed. Should the Company, following the advice of their chemical and medical authorities, consider the milk of an inferior quality—and therefore unfit for use—they shall be entitled, without any compensation to the contractor, to refuse to take any milk supplied by him."

Let us now follow the milk after its arrival at the Frederiksberg station (a suburb of Copenhagen). It is at once taken to the large premises of the Association, where it is sampled, and its temperature taken; all that comes at night (from the morning's milking) is put, in the cans as it is, into large ice-boxes, where it remains until early morning. This is usually sent up to town as children's milk, sweet milk, half-skimmed milk, and cream, all in separate cans.

The milk arriving from the evening milking by the early morning trains is also placed in ice until required, but it is sent out as sweet milk, and is sold at double the price of the half skimmed milk. Some of the milk, also arriving at this time, is sold at a still higher rate, as special precautions are taken to ensure its absolute purity. This is spoken of as "children's milk," and at one time even greater distinctions were made than are now insisted upon, but the sets of regulations have gradually approached one another, not by a levelling down but by a levelling up process.

In the first instance, the cows supplying this special article

for children were inspected more frequently than the rest, but such was the demand for the higher class of milk, and such the good results of strict attention to this point, that, ultimately, the whole of the cows supplying milk to the Association were put under the more rigid and more frequent inspection. In summer the conditions as to food and open air life are alike for the cattle supplying children's milk and those giving ordinary milk, the only difference being that none but the very best animals are kept for the children's milk supply.

During the winter months the food for these cows must be hay, straw, oats, barley, and a small quantity of carrots. Of course a higher price has to be paid for such milk, and there is perhaps less profit on this than on ordinary milk, but those who have the management and control of the Association consider that the welfare of the children of the community should be the first consideration in a matter of this kind, and they accordingly sacrifice a certain percentage of their profits for this laudable object.

The sweet milk is simply weighed, sampled, kept in ice until morning, and then put through a filter, by which most of the gross impurities are kept back. This filter consists of two enamelled iron tanks placed at different levels; a pipe in the form of a siphon has its long limb connected with the bottom of the upper tank and its short limb with the bottom of the lower tank, so that milk poured into the upper tank comes up as a kind of spring at the bottom of the lower one. On the bottom of this lower tank is fitted a perforated plate to which is affixed an upright spindle with a screwed thread at the top. Sponges are packed firmly over the perforated plate, after which a similar perforated plate is guided down by the spindle, pressed well home and kept in position by a nut which screws down on the thread above described. From the upper part of this lower tank a couple of pipes lead to a large storage tank, from which a pipe conducts the milk to the canning or bottling room. When the milk passes in at the bottom of the lower tank, it must, in order to get to the level of that above, pass through the compact layer of sponges, which keeps back a very large proportion of the particles which usually form the sediment of milk; as it rises it is run off into the large storage tank. It may have to stand here for a few minutes, and as during every minute that it stands a

certain proportion of the fat rises nearer and nearer the surface, Mr Busck has devised a perforated upright pipe so constructed that the area of the whole of the perforations is equal to the bore of the pipe leading to the tap, by which arrangement an equal proportion of fluid is always taken from each layer of milk as the emptying process goes on.

There are four of these large filters—one for cream, one for children's milk, and two very large ones for the other milks. Through one of the two large ones the sweet milk is first passed, through the other half-skimmed milk, and then, in some cases, the buttermilk, so that the lower classes may not interfere in any way with the better qualities. From the storage tanks the milk is drawn off and weighed into larger or smaller tins to supply the various customers and milk distributors, an accurate list of whose requirements is prepared from the returns of the previous day. The cans, after being filled and weighed, are labelled, tied up with a thread, sealed with a leaden stamp seal, and taken off to the milk carts for distribution. For the children's milk there is, as we have said, a separate filter placed in a separate room. In the next room is a most busy scene. The milk is led by a pipe into a machine similar to that used for bottling beer, at just such a rate that it will keep six small taps going. From these taps a skilled bottler fills clear glass bottles, each of which holds nearly a quart; as these are filled they are passed on to a woman who corks them by machinery, and hands them on to the sealers, four in number, who first tie threads across the cork, and then put on a leaden seal which is compressed and stamped by the foreman, so that until the milk gets into the hand of the purchaser there can be no tampering with it without his knowledge. The bottles are then placed in racks in boxes placed there by the different van-men, each one of whom knows the number he requires, are covered with ice, and are sent out to be distributed to the shops or by carts and vans. So important is this trade that the apothecaries undertake the distribution of the pure children's milk, especially on Sunday, when the other shops are closed.

The night I was in there were two thousand of these bottles ordered. The cream is treated in the same way as the children's milk—every can is weighed, sampled, tested by an experienced taster, and submitted to analysis both on the premises and in the

Chemical Laboratory, under Dr Bohr's supervision. It is divided into first and second quality, and a taster has sometimes to examine a couple of hundreds of samples in a single day. After this examination it is filtered and bottled in half pint, pint, and quart bottles, sealed, put in boxes left by each carter, iced, and removed to the carts as required. This work commences about nine o'clock at night, and goes on for two hours, and then begins again at about half-past two in the morning, when about thirty people may be seen working away like a lot of bees, handling and pushing about bottles as though they were engaged in some wonderful conjuring trick or other.

The care does not stop here. The milk carts are so constructed that there can be no tampering with any of the cans. If the milk is for distribution on the streets every door is sealed, whilst in the case of cans for large institutions, which are sent out on open waggons, each can is sealed. In all cases the cans are surrounded by ice in hot weather, so that every precaution is taken that the milk shall reach the consumer in good sound condition. Every milkman is in uniform, and every cart and van has the trade mark of the Association—a red and white clover blossom with green leaf on a black triangle painted on a pink ground. The greatest compliment offered to the success of the Association is that numerous private companies have imitated this emblem, as far as they could, without infringing the trade mark laws.

The returned milk is sold at a greatly reduced rate, or some of it is given out gratis to the very poor of the district, who are extremely anxious to obtain this pure sweet milk. What cannot be used is made into butter which is sold at a somewhat lower rate than that made from the best cream.

There are over 150 people employed in the establishment, whose work during the day-time is as follows:—First, there are the cans to be washed. This is done by rinsing them out with cold water two or three times; they are then thoroughly cleansed and sterilised by jets of steam driven into them at high pressure, after which they are again well rinsed with cold water and allowed to drain, mouth downwards, on racks, and sent off to their destination, or labelled for the reception of the orders for next day.

The bottles as they come in are most carefully washed, first with

warm water and soda, the inside is then scrubbed with a revolving brush and boiling water, and the outside is treated in the same manner with a small hard brush, after which they also are carefully rinsed with clean cold water. Before they are filled the threads to tie in the corks are tied on the neck, and all is prepared for the sealing process.

The filters are scrubbed, dried, and covered up so as to be protected from dust until they are again required. The sponges are collected in wire crates, and are cleansed by being subjected to superheated steam at a high pressure for ten minutes; this is repeated time after time until the condensed water comes through quite clear. The sponges are then rinsed in cold water and subjected to pressure between india-rubber rollers until not a trace of fat is left on the rollers after the sponges are passed through. Mr Busck, the inventor of the whole process, lays great stress on the necessity of having these sponges sterilised and cleansed each time they are used.

In such a large establishment there must be the most absolute discipline; promotion goes by merit and not by favour, and the slightest deviation from regulations is visited by most severe punishment in the form of degradation or dismissal, and attention to the rules is insured, as far as possible, by giving a premium to those who obey them to the letter.

There is the strictest supervision of the health of those employed. Should any infectious disease make its appearance in the family or residence of any of them, they are ordered to report the fact at once to the medical officers employed by the Association, who are authorised to suspend them from work until they consider it safe for them to resume. Although suspended from work these people are paid their full wages, so that they have not the slightest temptation to conceal any case of illness, occurring around them, from the doctor. In addition to this, they are fully aware that should they be detected in any concealment they will be punished by instant dismissal, and as the wages paid are exceedingly high, there is every inducement to conform to these rules as to notification of infectious diseases. The doctors also make a regular inspection of all the employees and their families, so that every possible precaution is taken.

Some idea of the enormous business done by the Association

may be gathered from the following figures. In 1880 the daily consumption of milk was 13,677 lbs. (a pound is nearly a pint), whilst in 1889 it had risen to 36,099 lbs. (18 tons per diem, or 6000 tons in a year). Of this a very large proportion, nearly a tenth, is supplied to asylums, children's homes, hospitals, and like institutions at greatly reduced rates, or given gratis to the very poor.

The Copenhagen Milk Supply Association has done a great work. Mr Busck and his coadjutors have solved a most difficult problem : they have built up a model, which has been copied with more or less accuracy and attention to detail in many of the large continental cities—St Petersburg, Paris, Berlin, Amsterdam, Stockholm.

I went over the Stockholm Association premises, where I again received the greatest attention and courtesy at the hands of the managers and proprietors. The principle is the same, but the details differ in some respects, as here there is a new plan grafted on to an old business. The principal shareholder in this company, Mr Lidholm, took me to see his large dairy farm, situated about fifty miles from Stockholm, and a more perfect farm and cow-houses I have never had the opportunity of examining. The principles brought into practice are careful selection of the cows, good feeding, regular exercise, good ventilation, and absolute cleanliness. I should like to give a full description of these cow-houses, but time will not allow of it.

We have made attempts, even in this country, to improve our cow-houses, our dairies, and our milk supply, but there is still much room for improvement in every department; and we should not rest until, for the sake of the health of the community, these are brought to perfection.

From what I have already said I think that most of you will be able to predicate what steps I should like to see taken to ensure a good milk supply.

The dairy farms should be most carefully controlled. I am not by any means an alarmist, and I am assured that in many instances, in fact, in most, the greatest care as regards cleanliness is exercised on the large farms. On the other hand I know, from personal experience, that some farms are in a most disgraceful condition, and one such farm may leaven the whole,

in a very literal sense. We must remember that legislation is for those who do not attend to these matters, and these are the people who are most likely to grumble. I should like to suggest, and have already done so frequently, some such points as the following, as those on which special stress should be laid by our local authorities. Every case of illness in the dairy farm should be reported *immediately* to the proper authority. I say every case, because we are coming to see that what have hitherto been looked upon as harmless conditions may after all have a very important significance. The most trifling ailment should be notified, and this notification should be made compulsory. District Inspectors of farms should be appointed, one an expert in veterinary practice and science, a second a medical expert, skilled in hygiene and sanitation. All cases of disease, whether in the dairy stock or dairy staff, should be reported at once under very heavy penalties. A careful and frequent inspection of all farm premises, drains, ventilation and cattle, and even of those working amongst the cattle, should be carried out by both inspectors, independently and in conjunction. The whole of the apparatus should be tested, as regards its cleanliness, not merely by inspection, but by fermentation experiments. The arrangements for boiling or steaming milk pans, and for cleansing the persons and hands of the milkers, should be under the absolute control of these inspectors, who should report not annually merely but fortnightly, so long as all goes well, and weekly should any suspicious disease appear on the farm. A certificate based on the results of such report should be granted periodically to each dairy, farmer and to each dairy keeper, and without this certificate no one should be allowed to sell milk. It may be said that some of the restrictions I have mentioned are too stringent, in fact that I should like to introduce a grandmotherly element into our legislation on the subject. We must, however, remember that such legislation is not for individuals merely; it is for the general weal, and eventually it will be for the welfare of the dairy farmer.

The selection of stock for the breeding of healthy cattle, the conditions of lactation, and similar matters of importance might be freely enlarged upon, but the discussion of such subjects must be left to some other occasion.

NERVE EXHAUSTION IN WOMEN.

By D. BERRY HART, M.D., F.R.C.P.E.

"All work of Man is as the swimmer's: a waste ocean threatens to devour him: if he front it not bravely, it will keep its word."—CARLYLE in "Past and Present," chapter xi.

"The great danger to be feared for girls is that they will overwork themselves. . . . There is in her physical organisation a power of defrauding herself of sleep, of food, and of exercise, until it affects her constitution, and may, year after year, lay the foundation of disease." —CHARLES KINGSLEY, "Social Science Trans.," 1869, p. 361.

IT may seem to you, on first thought, that the subject of Nerve Exhaustion in Women is not one of much importance to most of you here to-night. The popular opinion is, no doubt, that nervous disturbances, apart from actual lunacy, occur only in few cases, and that in these there is probably hereditary disposition, or a want of that serious occupation which is supposed to be a preventive of such a catastrophe. This opinion, however, is not correct. Nerve exhaustion is much more common in this country than is supposed. It begins even in school days, and is likely to be more prevalent if women push on, as they are in the opinion of most of us, rightly doing to the work hitherto exclusively belonging to men. It is therefore worthy of our most serious consideration. It is not enough to prove that what men do, women can do as well: we must see that in this attempt the bodily constitution of women does not suffer. This is a most important question for the race, inasmuch as it is our best women who are competing with men, and, accordingly, if our best women deteriorate, posterity will suffer seriously.

In bringing this matter before you, it will be convenient to take it up under definite heads :—

1. *What do we mean by the nervous system : what, in brief, are its functions, and how is its waste repaired ?*

2. *In what way and at what periods of a woman's life may nervous exhaustion arise ?*

3. *How can it be avoided and how remedied ?*

The *nervous system* includes the brain and spinal cord, with the nerves issuing from them. As you all know, the brain lies within the skull, the spinal cord in the spinal column or backbone, as it is popularly called. There are, however, really four great divisions of the brain and spinal cord, viz.,—the *cerebrum, cerebellum, medulla oblongata,* and *spinal cord.* A few words on the functions of these.

The *cerebrum* is by far the larger part of the brain, and is concerned in all mental processes. Thus it is the seat of the will, of thought, and of feeling. An animal like the frog, if deprived of the cerebrum, becomes perfectly passive, but by stimulation can be made to walk or swim ; acts, in fact, like a machine. In the remarkable condition known as the mesmeric trance or hypnotism, the person mesmerised has temporarily the use of the cerebrum suspended, and thus acts like a machine, doing whatever is suggested by the hypnotiser.

The *cerebellum* is concerned in the balancing processes of the body, so that, if removed, all power of regular or arranged muscular movement is lost. Its functions, however, do not concern us to-night.

The *medulla oblongata* is the most important part of the nervous system, so far as vital processes are concerned. In it are placed the centres for breathing, regulation of the size of the blood-vessels, and many others we need not mention. Injury to it is, of course, exceedingly serious and may be fatal.

The *spinal cord* has issuing from it the nerves of motion and sensation for the trunk and limbs, and is also concerned in transmitting all impulses independent of our will, *e.g.*, in carrying out what is termed reflex action.

The nervous strength of all these divisions is not equal. When chloroform is given to any one during an operation, consciousness is first lost, *i.e.*, the cerebrum loses its power temporarily. Reflex

action is next abolished (spinal cord, medulla oblongata), and then, if the administration be pushed beyond this limit of safety, we get stoppage of respiration and of the heart, causing death. This shews us, then, that the part of the nervous system concerned in mental processes is the one to become exhausted first.

The brain and spinal cord are termed the central nervous system, and from them issue what we know as the nerves. The nerves convey messages from the central portion of the nervous system to the various parts of the body. Thus in any one playing the piano a constant series of messages is passing from brain to fingers; when we feel a pain a message is sent to the brain giving accurate information as to the nature and locality of the pain, and so on. There is, however, a very important set of nerves which are not entirely under our control, and which are concerned in regulating blood-flow, the movements of the heart, the functions of the digestion, and of other organs. These form what is termed the sympathetic system. This system begins in the medulla oblongata, and sends filaments all over the body. The functions are so important that we must give a little detail in regard to them. In the first place, the sympathetic system regulates the size of the minute blood-vessels. When one blushes, the nerve filaments have allowed the small blood-vessels to dilate, more blood to distend them, and thus the rosy blush. The opposite of this gives pallor. This system also regulates the heart's action, has an important part in digestion, and other functions too many to enumerate. On the perfect condition of our nervous system depend healthy mental processes, the healthy action of the heart, digestion, sweat secretion—in one word, our Health.

One final function of the nervous system must be noticed, viz., that of restraint. We have in a normal nervous system a power of restraining or inhibiting nervous action. Restraining a sneeze is a familiar instance. More important is the guarding of the emotions, control of irritability under excitement, and other restraints familiar to all. Without this power of inhibition of the nervous system, we should be liable to sudden excited conditions, of which the best known is hysteria.

But while the nervous system in this way rules the body, it is also dependent for its healthy action on the condition of the blood, on proper food and its accurate digestion. Given poor

blood and defective digestion, then the nervous system becomes poisoned and is enfeebled; and in return the body tissues themselves suffer. One striking instance of this in the economy of the body may be given. The liver is one of the most important organs in the body, and has among its many duties a very peculiar one. In healthy digestion, and more especially in indigestion, certain poisonous substances are formed. All blood from the stomach and other digestive organs passes through the liver before it reaches the general circulation. Now, the healthy liver has the power of destroying these poisons while they pass through it, and this accounts for the depression of spirits and morbid views one so often takes in the derangement known as biliousness! Here the liver is sluggish and inactive; poisonous products circulate in it, and from the effects of these on one's brain, we get the depressing results so readily dispelled by simple remedies. As Sydney Smith has wittily said:—"The deception, as practised upon human creatures, is curious and entertaining. My friend sups late; he eats some strong soup, then a lobster, then some tart, and he dilutes these esculent varieties with wine. The next day I call upon him. He is going to sell his house in London and to retire into the country. He is alarmed for his eldest daughter's health. His expenses are hourly increasing, and nothing but a timely retreat can save him from ruin. All this is the lobster; and when over-excited nature has had time to arrange this testaceous encumbrance, the daughter recovers, the finances are in good order, and every rural idea effectually excluded from the mind.

"In the same manner old friendships are destroyed by toasted cheese, and hard salted meat has led to suicide. Unpleasant feelings of the body produce correspondent sensations of the mind, and a great sense of wretchedness is sketched out by a morsel of indigestible and misguided food. Of such infinite consequence to happiness is it to study the body."

But you may say, if the nervous system has such important work, how does it ever get rest? How can we prevent its overwork and the consequent serious results? This over-work can be avoided:—Sleep is the time of rest for the nervous system. The cerebrum and spinal cord then get complete rest, and those parts of it regulating breathing, and the heart's action, doze,

as it were, at their posts. Breathing is slower during sleep, and the pulse falls. But another important method of rest is by proper recreation or change of employment. The brain, fatigued with mental work, gets rest when a sharp walk is taken or some game played. A walk in the country, a game of tennis, may completely rest the brain and give the spinal cord and centres for breathing the extra work which makes up for their partial idleness during the lessons of the school-girl or the book-keeping of the clerk.

2. *In what way and at what periods of a woman's life may nervous exhaustion arise?*

In nervous exhaustion there is a lowering of the working power or vitality of the nervous system, so that not only is its special work imperfectly done, but serious bodily derangements arise. What are the causes of this? They are, in general, over-work of the brain, as in prolonged mental effort; neglect of recreation or change of employment; curtailment of sleep; the giving of undue prominence to the worries of life;—in one word, over-work of the thinking powers while the other parts of the nervous system and body have not their fair share of duty.

Now, much depends on the individual. George Eliot, for instance, could tire out the strongest man in sustained mental effort, yet, after her "Romola" she saw "how cruelly she had suffered from working under a leaden weight at this time." In her own words—"I began it a young woman,—I finished it an old woman."

In ordinary natures, however, the effects of undue strain of the nervous system are as follows:—First, we have headache and disinclination to work; the work is forced, done under effort, loses its usual spontaneous character. Then follows distaste for food, indigestion, loss of sleep, pallor from want of proper blood, sickness on exertion, all ending in an amount of prostration varying in each individual case. Thus in many it is simply a feeble condition of health; in others we get hysteria; and in a third class, complete prostration and inability to perform any active duty.

How can we explain this chain of disturbances? Undoubtedly, it begins with over-work of the nervous system. This lowers the vitality of the tissues, and especially affects the tone

of the blood-vessels. During sleep the brain has less blood in its vessels, this being brought about by the action of the sympathetic nerves diminishing the capacity of the small blood-vessels. These, however, are over-tired, and therefore we get the brain, excited by fulness of blood, driving off "Nature's sweet restorer." The sickness is to be accounted for in much the same way.

Headache and neuralgia are early and prominent symptoms of nervous exhaustion and give timely warning of mischief, bidding the sufferer beware. One is struck in reading George Eliot's life with her sufferings from headache.

The evil may be more rapid and serious than what I have already described, and no one has pictured it with more medical accuracy and literary beauty than Louis Stevenson.

"A Student, ambitious of success, by that hot, intemperate manner of study that now grows so common, read night and day for an examination. As he went on the task became more easy to him, sleep was more easily banished, his brain grew hot and clear, and more capacious, the necessary knowledge daily fuller and more orderly. It came to the eve of the trial, and he watched all night in his high chamber, reviewing what he knew, and already secure of success.

"His window looked eastward, and being (as I said) high up, and the house itself standing on a hill, commanded a view over dwindling suburbs to a country horizon. At last my student drew up his blind, and still in quite a jocund humour looked abroad. Day was breaking, the east was tinging with strange fires, the clouds breaking up for the coming of the sun; and at the sight nameless terror seized upon his mind. He was sane, his senses were undisturbed; he saw clearly, and knew what he was seeing, and knew that it was normal; but he could neither bear to see it nor find strength to look away, and fled in panic from his chamber into the enclosure of the street. In the cool air and silence and among the sleeping houses, his strength was renewed. Nothing troubled him but the memory of what had passed, and an abject fear of its return.

> "Gallo canente spes redit
> Aegris salus refunditur,
> Lapsis fides revertitur,"

as they sang of old in Portugal in the Morning office. But to him that good hour of cock-crow, and the changes of the dawn, had brought panic, and lasting doubt, and such terror as he still shook to think of. He dared not return to his lodging; he could not eat; he sat down; he rose up; he wandered; the city woke about him with its cheerful bustle; the sun climbed overhead; and still he grew but the more absorbed in the distress of his recollection and the fear of his past fear. At the appointed hour he came to the door of the place of examination; but when he was asked he had forgotten his name. Seeing him so disordered, they had not the heart to send him away, but gave him a paper and admitted him, still nameless, to the Hall. Vain kindness, vain efforts. He could only sit in a still growing horror, writing nothing, ignorant of all, his mind filled with a single memory of the breaking day, and his own intolerable fear. And that same night he was tossing in a brain fever.

"People are afraid of war, and wounds, and dentists, all with excellent reason; but these are not to be compared with such chaotic terrors of the mind as fell on this young man and made him cover his eyes from the innocent morning. We all have by our bedsides the box of the Merchant Abudah, thank God, securely enough shut; but when a young man sacrifices sleep to labour, let him have a care, for he is playing with the lock."

We must now consider the special periods in a woman's life at which the liability to nerve exhaustion is present. These are practically found in the school-girl and adult woman. In older women there is less tendency to this, as the body degeneration of old age gives lack of power for this evil. The keenness in the battle of life has gone by this time, and other fresher brains are carrying on the fight.

Since the introduction of the new Education Act into this country, it has often been urged that the result of educational pressure in Board Schools has been hurtful, so far as the health of many of the children is concerned. So far as the Board Schools of Scotland are concerned, this has not been shown to be the case to any appreciable extent, and I do not suppose one can take the recent boyish strikes as evidence. At any rate the non-participation of the girls shows that the over-pressure had not

affected them. We must remember, however, that education has long existed in Scotland, that an heredity of facility is developed on this point, and that in our Board Schools there is ample provision for recreation in the intervals of lessons.

In some of the higher girl schools, however, of this town, such pressure does exist. School work in some of these takes up six continuous hours, with no breaks except for the necessary change of classes, and with no outdoor exercise during that time. If we add to this an average of two to four hours for the preparation of lessons, we find girls at ages from nine to sixteen working on an average from eight to ten hours daily. This amount of continuous work is absurd, and is productive, as I know, of headache, lassitude, and even more serious nervous disturbances. For this the parents are in great part to blame. So many hours continuous mental work is productive of harm to the mind, as a similar period of continuous eating would prove to the body. It must lead to cram, that process of which Professor Blackie has so wittily said, that "it has no appetite before, and no digestion after."

But let us consider more particularly the effects of the cramming and sedentary method of education on girls at the time when their tissues are actively growing. We find that during a period of eight or nine months a year she is subjected to the strain of a working day of at least nine hours. During this time the effort is mental, and thus we have work of one part of the nervous system for this long period. The other functions of the body are being carried on sluggishly. Take the case of some of these organs. You all know that atmospheric air is absolutely necessary to existence, and you further know that the air passes into the lungs pure and comes out of them comparatively foul, *i.e.*, it is warmer, contains a hundred times more carbonic acid than atmospheric air, and has a small proportion of other noxious gases. These come from the blood-vessels of the body distributed in the lungs, as it is in this way necessary impurities are passed out of our blood. Now, during exercise, three times the amount of air is taken into the lung, as compared with the amount entering when we are at rest. So that exercise increases greatly the passage out of noxious matters. But this is not the whole evil of prolonged confinement, inasmuch as the air breathed in again in a schoolroom is necessarily contaminated air.

But, further, during the enforced rest we get a reduction of the force and frequency of the heart's beat, inactivity of muscle, and an accumulation of waste matters in the body. These waste matters are of great importance. You have all seen a paper-mill—from the outside at anyrate; you know the valuable material we get from it; and you also know how much poisonous material issues from it, polluting our streams and making them a nuisance. Now our bodies are much the same. You know that in a fire the actively burning coal soon becomes ash, and that if the ash accumulates and blocks the bars, the fire goes down, even though there may be abundance of fresh coal still present. By digestion our food is carried by the blood-vessels through the body, passes into the tissues by minute vessels, and gives them the nourishment they need. But these tissues form waste products, just as the fire forms ash, and this waste tissue must be removed. This is greatly done by breathing and by muscular exercise. Our lungs rest on a muscle of great importance—the diaphragm—which helps to expand the chest, and also by compressing the liver aids it in expelling bile. Those who tight lace do not believe in this, but it is true all the same. You see, then, that if a growing girl, as she is often termed, does not get abundant daily exercise — running, jumping, games involving abundant muscular movement—her vitality will be lowered as the blaze of the fire is diminished when the ash is allowed to accumulate. Of course it may be said that ventilation and gymnastics will do what is required: but this is untrue. Nothing will make up for outdoor exercise and fresh air.

If we take a small piece of muscular tissue of the body we will find that it has (1) a nerve; (2) a small artery pouring blood into (3) many capillaries; (4) veins and lymphatic vessels bearing blood and lymph away. This piece of our flesh has its definite standard of health depending on a healthy condition of its nerves, proper nourishing blood's entering it by the artery, and waste products' leaving it in the venous blood and by the lymphatics. This tissue will degenerate if the nerve's health is lowered, if pure air and food are not carried to it by the artery, and if its waste products are not removed. The quickest way to deteriorate the muscle would be to prevent its contracting or working, because during this contraction the flow of blood through it is increased,

its food more frequently given and its waste more quickly taken away.

If, then, a girl has many hours' school confinement, walks sedately home, eats her food with diminished appetite, and then begins home preparation without proper recreation, she is certain to get deteriorated in blood, muscle, and brain. I would have all mothers to consider this matter seriously, to remember that bodily health may be sacrificed to learning, and that damage done in early life cannot be readily repaired. Undue prolonged strain of the brain and neglect of the body seem to me the great fault of the modern education of girls.

The result of such unbroken mental work is therefore serious, and I would urge that in all girls' schools the period of school study should not exceed four or five hours, and that there should be an interval of one hour at least for outdoor recreation. Then some effort should be made to reduce the amount of home preparation. Further, in all large schools why should there not be a recreation field for girls as there is for boys. The physical training for girls is as important as that for boys, and cannot longer be neglected. Girls, indeed, require to be specially protected against over-pressure. They work more eagerly than boys ; suffer more from nervous strain ; and, having less outlet for physical exercise, are correspondingly more confirmed in nervous tendencies. Especially between the ages of thirteen and sixteen should educational pressure be lowered,—the loss then, if any, will be easily made up afterwards. For, after all that is at present being done in the education of girls, we must remember that nature has fixed the destiny of most already, that comparatively few will ever gain their livelihood as men do, and that an average undue pressure on girls must be disastrous to the race.

Taking up now the case of the adult woman, you will easily grasp how the same evil of nerve exhaustion may arise. Very often it is started by the self-sacrifice involved in nursing a sick relative. Given the acquired and almost inevitable selfishness of the chronic invalid, one can easily note how the devoted nurse, whether sister or mother, with the high sense of duty so often found in highly strung women, speedily suffers, and may soon take the place of her patient. Again it may arise from educational over-pressure. Then there is no doubt that women in

shops not only have long hours and continued strain, but are denied even the simple matter of a seat during work. They are often, indeed, too tired for recreation after their work. The same holds good as to domestic servants. Much of the want of harmony between mistress and maid is due to the lowered nervous tone which must come on in women who have the long hours and little recreation of a servant. I am sure that servants might arrange among themselves so as to give each other a day's outing occasionally, and that their mistresses would soon find the inconvenience to themselves amply compensated for by the smoother working of that great cause of health depreciation to women—housekeeping.

I have now very briefly, and I fear imperfectly, sketched the process of nerve exhaustion in women, and have had to omit much on this that might have been useful. Let me now turn to the question of treatment. Here we must keep in mind the great fact that while nerve-tissue takes long to break down, it takes longer to repair. A thorough exhaustion may take years to recover itself and may never do so. Hence the great importance of prevention. Every woman should have work to do, but should work within her strength as much as one lives within one's income. We can all understand a financial breakdown, but how few think of their nervous system as something that may be overdrawn or even beggared. Then recreation must be attended to. The brain-worker will give rest to the tired brain best by physical exercise. The importance of outdoor exercise to women cannot be over-estimated. I do not mean by this a languid crawl in that rigid armour of clothing women seem to think indispensable, but a good smart walk with the ascent of a hill at the end of it, and the jostle and tumble up of the descent too.

The outside of a horse has been described as the best thing for the inside of a man; but failing that luxury, I know nothing better than to climb the Braids or Blackford Hill or Arthur Seat. This for those who need physical exercise. Many, however, have enough of this in their work, and need to educate their minds rather. For these our various museums and, above all, the Free Library will afford ample opportunity.

But what if the mischief has gone on to the production of head-

ache, sleeplessness, loss of power of concentration, and the other symptoms already given? Here, there is nothing for it but to limit the amount of work, increase the amount of food and physical exercise, and, if possible, take change of air and scene, the best place being some bracing seaside resort. This, however, is precisely what it is difficult to persuade these sufferers to do, and we accordingly find them anxious to try the effect of stimulants and sedatives. Nothing can be worse than these. Many a good life has been wrecked by them. How foolish to take that which merely goads on a jaded mind to leave it more wearied; or to establish a habit of narcotism. Any sacrifice should be made before mortgaging one's body and soul to such Shylocks as drink, chloral, or opium.

In those extreme cases where the woman is prostrated by the exhaustion and has become utterly unfit for further healthy work, a systematic course of rest, over-feeding, and massage, first introduced by Weir Mitchell, often works marvels. This treatment is a mere magnification of what I have already recommended. Complete isolation gives the jaded nervous system rest by removing all old influences; abundant nutritious food is made to flush the tissues, and waste is removed rapidly by the special rubbing employed. This is really a means of muscular exercise to the patient without the loss attendant on self-performance. In this way the emaciation is quickly repaired, the jaded mind rested, and soon the sufferer can take her place as active as before and, we hope, having profited by the lesson she has learnt.

In conclusion, I would urge on you all the importance of work, but I should add that work by women must be wisely done; that change of occupation and recreation must be considered not only as a pleasure but a duty. The cultivation of the mind of women must not be at the expense of the body. Hand in hand with mental culture must bodily culture go, if disaster is to be avoided.

HOME SICK NURSING.

By Miss MUSGROVE,

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Nursing at home is a very difficult matter, compared with nursing in a hospital. In the latter, everything is arranged with a view to the special work of nursing the sick; but in a private house this is not so, and the ordinary every-day work has to be done as usual, with the addition of a patient to be attended to, the patient sometimes being one of the workers in the household. Remembering this, it is important to arrange the sick-room so as to require as little work as possible in keeping it clean and tidy.

A great mistake, now-a-days, is that we overcrowd our houses with furniture, and when this is done in the sick-room, the large articles take from the breathing space of the patient, and the fancy things and ornaments collect dust, and occupy time in cleaning, which might be better spent in looking after the patient; besides, they are easily knocked over, and the noise startles a nervous invalid, and does almost as much harm as a blow would do.

It is most important, if choice *can* be made, to have a bright, sunny room, facing south, or south-west: a large room is also preferable to a small one, being easier to ventilate. In choosing wall-papers for bedrooms, it is well to select quiet, harmonious colours, with indefinite patterns, in preference to the brilliant, formal papers, which invariably trouble a patient; since he cannot resist counting, and making endless patterns and figures out of bright red roses and brilliant green leaves, when these meet his eye on the walls.

In preparing the room, let the floor and woodwork be wiped with a damp cloth, not scrubbed, unless some hours elapse before the patient is moved into it.

Look to the door and windows, and see that they open and close easily and without noise. The rattling of a window can generally be prevented, by inserting a small wedge of wood between the sash and the framework; and a little oil will cure a squeaking door, both of which noises would prove a source of annoyance to an invalid.

If a fire has not been in the room for some time, light it some hours before the patient is moved in, both for the sake of warming the room, and of getting rid of the puff of smoke that comes down a cold chimney, which is trying alike to the tempers of nurse and patient. Opening the window a few inches from the top is more likely to cure a smoky chimney, than opening it from the bottom.

If a fire is not needed, see that there is a clear passage up the chimney; the register will probably be found closed, or failing that, a bag of shavings pushed up, thereby hindering the free ventilation of the room. If the window is kept open day and night, a couple of inches from the top, and if there is a small fire or open fireplace, the air of the room will be kept pure, and there will be no likelihood of poisoning the patient with bad air. When the window cannot be left open at the top, put up the lower sash, and insert a piece of wood four or five inches deep, to fill up the opening. By this means the fresh air comes in between the upper and lower sashes, and the current being directed upwards, the air is diffused throughout the room and a draught is avoided.

To test the warmth of the room, have the thermometer on a level with the patient's head, not near the door, window, or fireplace; and let that be the guide as to the heat, and not the nurse's feelings, which often mistake closeness for warmth.

A fire should be kept burning day and night, since the temperature of a sick-room should be equable. It will be found well to put away the ordinary coal box and fire-irons, and use instead, a basket lined with felt or brown paper, to hold moderate-sized pieces of coal. These should be lifted on with a piece of paper; or a better plan is to have a large glove to slip on the

hand, thus avoiding soiling the hand and causing extra work. An old walking-stick may be used instead of the poker, and by these means, all can be done so quietly that the patient never needs to know when the fire is being replenished.

Visitors should only be allowed in the sick-room with the doctor's permission, and their chair must be placed *opposite* the patient, and not alongside of him, as this would cause him to twist his neck round most uncomfortably, to see his visitor. A visit of ten minutes will probably cheer a convalescent patient, but if ten minutes more are taken up in saying "good-bye," harm, rather than good, will be the result. No whispering or walking on tip-toe should be allowed, but everything should be done in a clear, distinct, and natural manner.

A nurse will find that she does her work more easily in a light, plain dress, than in an ordinary one. In summer, a print or holland gown is the best, and in winter, a plain serge. The former ought not to be starched, as the rustle of such is apt to irritate an invalid. A clean apron, collar, and cuffs will go far to make the nurse acceptable to her patient, especially if she has a bright cheerful face above them.

In home nursing, a frequent but serious mistake is that there are half-a-dozen nurses and no one is responsible; so that whilst the patient is too well looked after during one part of the day, he is neglected at other times. One person should be the head nurse; taking the orders from the doctor, and seeing that they are carried out, arranging and apportioning the work so that no member of the household gets worn out in a few days, and thus increase the number of invalids to be looked after.

In sitting up at night, three or four people cannot do more than one or two; and it is far better for the others to rest and be ready for the next day's work.

From two A.M. till sunrise is the coldest part of the twenty-four hours; therefore both nurse and patient should have an extra wrap provided, and the fire should be kept up, and if needful, a hot bottle can be placed to the patient's feet, or a warm drink may be given to him.

In putting a hot bottle or brick to a patient, it should always be wrapped in flannel, and special care must be exercised in the case of paralysed patients and those suffering from dropsy;

children, and elderly people also, cannot bear the same amount of heat that others can.

If a patient is unable to speak, it does not follow that he is deaf, there is no need to shout; but care should be taken to avoid speaking of matters which would distress him; for although he gives no sign, he may hear and understand what is being discussed.

Patients are often irritable and say and do things that they would never dream of in health, and a nurse has to exercise great self-control and patience, and to remember that this is part of the disease, and is often a sign of convalescence.

It will be found a great help in her report to the doctor, to have a paper divided into hours, upon which the nurse can write down such things as he requires to know about his patient. If she trusts entirely to her memory, the most important facts are frequently forgotten, and much time is lost in finding out what has really occurred.

In nursing sick children great tact is required; and unless a nurse has a heart full of love for them, she will be of little use. She must be able to enter into their thoughts and ways, and to put aside her dignity, and be as one of them. A child will do much for a wise, loving nurse, for children are quick to find out those who care for them; and the time spent in amusing and playing with them is appreciated by the little ones, who will obey such a nurse, more readily than one who may be perfection as regards nursing, but who does not understand children.

It is no kindness to let a child have everything he wants because he is ill, and by a little tact he may be diverted to some other object than the one he fancies, and thus tears and struggles may be avoided; or, the treat may be promised for another day, and if the child trusts his nurse, her promise will usually suffice.

If a bright lively child becomes cross and irritable, and cries for little or no cause, something is wrong, and the child is probably ill. It is well to put such a child into a warm bath, first trying the heat of the water with the elbow, if a thermometer is not at hand. This gives an opportunity to see if there are any scratches, or if the clothing has been too tight; and at the same time a rash will be detected if present, and the warm

bath soothes the child. Great care must be exercised, both whilst the child is in the bath and afterwards, that a cold draught does not undo the good the bath would otherwise effect.

Pain is often caused by too large a quantity of food having been given. Babies can only express their discomfort in one way, namely, by crying, if we except the varying expressions of their little faces, would we but take the trouble to study them. And to think that because a child cries he requires feeding, whether the cry proceeds from undigested food or is the result of a pin running into him, is a very great mistake.

If a child takes little notice, and will not laugh and crow, it is undoubtedly ill, and advice should be sought at once; its life is so easily snapped that delays are dangerous.

Croup is one of those things that will not brook delay, and without waiting for the doctor's arrival the nurse must try and give relief with the remedies at hand. A teaspoonful of ipecacuanha, in a little warm water, should be administered every ten minutes, in serious cases; and if that is not at hand, mustard and water, or sweet oil and warm water may be given. Sometimes tickling the throat with a feather will cause the child to vomit, and this gives relief.

A sponge, wrung out of hot water and applied to the throat, can be quickly ready, and a poultice on the chest and well up to the throat should be applied as soon as possible, and will ease the patient. The head and chest should be raised to enable the child to breathe more easily.

Whenever poultices have been applied, the part requires protecting with flannel or cotton wool, which, besides preventing chill, keeps the clothing from rubbing against the tender skin.

It is a wise plan, when children are recovering from illness, to keep them in bed longer than is really necessary. When a child is in bed you know where he is; but if dressed and about, he will probably be out of the door, running up the street the moment he is left alone.

Often so serious a relapse is brought on by carelessness during convalescence (especially from a mild case of scarlet fever or measles) that a weakness is left, of which life-long suffering is the result, even if the life of the patient is spared.

There is a prevalent but mistaken notion that children must suffer from a certain number of diseases, or they will not grow up to be men and women. Unfortunately the process kills off a large number, and many who are left, live to blame the parent who put them in bed with one suffering from measles or scarlet fever; they know too well what they have had to suffer through their parents' superstition and ignorance.

Infant feeding scarcely comes within the range of my subject, but if children were fed in a more simple and natural way there would be less suffering and deformity; and if mothers, especially among the working-class, were not so much afraid of soap and water and fresh air, we should have healthier, and therefore better, men and women than many of the present generation promise to be.

In giving medicine, never deceive a child by saying he is getting something that is "so good." It may answer once, but the struggle will be greater the next time, besides of the harm that is done to the child's moral nature. Tell him that the medicine is not nice, but will do him good, and you usually find that children are not so bad as grown-up people about taking it.

If the mouth is dry and parched, moisten it by giving a little water before the medicine, for without it, the taste will remain for a much longer time; also, if the patient avoids touching the medicine with the lips, and a clean towel is at hand to wipe them immediately afterwards, the taste is sooner got rid of.

Spoons vary so much in size that it is very unsafe to measure with them; and if a disagreeable drug has to be taken by ourselves, we are sure to choose out the smallest spoon, but if for someone else, we may not be so particular.

A measuring glass, such as this, or a graduated spoon, can be bought for a few pence, and with these no difficulty is experienced as to the proper quantity.

Oil is usually given in a spoon, and if this is made hot by placing it in hot water for a short time, the oil more easily leaves it. A little dry bread or oatmeal taken after it, removes the taste of oil.

When medicine has to be given three times a day, arrange the hours so as not to crowd upon the meals; and having fixed the time, adhere to it; and do not give the medicine an hour

earlier one day, and an hour later the next, or a double dose to make up for one that was omitted.

Lotions and outward applications should never be kept with drugs to be taken inwardly. They should be in blue bottles with rough sides, and if there is a delirious patient or a child about, let them be locked up and out of reach.

In applying outward applications, the rule is, that hot ones are of no use when they become cold, and cold ones must be renewed as soon as they become warm.

In wringing out a fomentation flannel, there are required a bowl, round towel, two sticks or wooden spoons, piece of mackintosh, and about half yard of coarse flannel or old blanket, which retain the heat longer than fine flannel does. Place the towel across the bowl, fold the flannel and put it in the towel, and insert a stick at each end. Pour over it sufficient boiling water to saturate the flannel, then take up the sticks and twist them round in opposite directions, till the flannel is perfectly dry. Shake it so that the air gets between, fold up quickly and apply at once, with the mackintosh to cover over. There should be two pieces in use, so that one can be dried whilst the other is on the patient, otherwise it would only be warm, not hot, when wrung out a second time.

If a poultice is ordered, and the kind not specified, it is always safe to put on a linseed one. A mixture, half linseed meal and half ground linseed, is generally used; as if made entirely of the former, the poultice is apt to become dry and hard, the oil having been crushed out of the meal. Before mixing the poultice, have everything ready. If there is a wound, wash it and cover it with a piece of damp rag till the poultice is made. Small pieces of old linen, which can be burnt, are better for washing a wound than a sponge, which is not easily cleaned—at least, is often so carelessly cleaned that the sponge becomes a source of injury. In washing wounds, avoid touching the edges, as that gives most pain. Wash round them gently, and *towards*, *not away from* the centre of the wound, and, if necessary, squeeze the water over, or use a syringe with a piece of guttapercha tubing to the end, to break the force of the water.

For the poultice there are required, two bowls, one tablespoon, a spatula or old knife, a piece of rag, cotton wool, or tow (rather

larger than the poultice), linseed, sweet oil, and boiling water. Scald one of the bowls and spoon, and pour the water into the second bowl. Then pour as much boiling water into the first as is required for the poultice. Sprinkle in the linseed, stirring with the spoon at the same time, till it is the proper consistence. No quantities can be given, as linseed varies greatly in the quantity of moisture it absorbs. When it leaves the sides of the basin clean, and is a soft spongy mixture, it is ready. A poultice is improved by putting the bowl over a pan of hot water and beating it for a few minutes. Pour the poultice on the rag, spread evenly with the spatula or knife, which is first to be dipped into hot water, pour a little oil over to cool the surface, turn up the edges of the rag, and apply as hot as can be borne, but not hot enough to scald the patient.

If it has to be carried from one room to another, put it between two hot plates; and in trying the heat of the poultice, put it on the back of the hand, which is more susceptible to heat than the palm. A poultice on the chest can be kept in place by fastening a piece of tape to each corner, and crossing them at the back, or with a triangular bandage. After a part has been poulticed for some time, less heat can be borne than at first.

Many medical men discourage the use of poultices in such cases as bronchitis, &c., &c., on account of the great risk of chill from the gradual cooling, and during the process of changing. They prefer several folds of cotton wool placed over the chest and back of shoulders. These can be kept in place by tapes round the waist, and by being tacked together on each shoulder. Or a woollen singlet cut open down one side and across the shoulder (closed over the chest) can be lined with four folds of cotton wool, and fastened firmly down the side and along the shoulder with tapes.

To make a very strong mustard plaster, mix the mustard to a paste with cold water, spread this on several folds of tissue paper, cover it with a larger piece, and turn the edges of this over the back, to prevent the mustard running out. A piece of brown paper covered with old linen will do instead of the tissue paper.

Much of the comfort of a patient depends on the bed, and the way in which it is made. A narrow iron one is the best,

especially when a patient has to be lifted. If, unfortunately, it is high and wide, the nurse should stand on a firm footstool before attempting to move the patient, otherwise she may strain and hurt herself. A small iron bedstead is easily moved, and the nurse can get to both sides, and do her work better, both for herself and her patient. Feather and flock beds are apt to become lumpy, and cause bed sores; besides, if a patient is put on to a soft, downy bed, he sinks into the middle, and it is difficult to move him. A hair mattress is best; if that is not to be had, a well packed straw or chaff one should be used. The objection to the latter is the unpleasant odour which it often has. One advantage in using these is, that when they become soiled, they can easily be emptied, and the covers washed and re-filled at comparatively little cost. The fibre mattresses are good, and not so expensive as the hair ones.

If there is any tendency to bed sores, the under blanket should be omitted; the under sheet must always be large enough to tuck in all around, to prevent creases. Let the bed-clothes be warm but light, and avoid a heavy cotton counterpane, as it takes all the strength of a weak patient to lift it. Two or three good blankets, with a clean sheet over, or print cover, will be found best. The pillows should not be very soft; and especially in diseases where the breathing is difficult, a hard one should be placed so as to raise the head and shoulders. A "wedge cushion," such as I have here, is most useful. It is a wedge-shaped calico bag, stuffed very hard with chaff or chopped hay or straw, covered with chintz, and stitched through, to keep it in shape.

This may be used also as a bed rest, by placing it on end, and padding it with pillows, and will be found to give great support, besides taking up little room. An ordinary chair also answers very well, in the absence of anything better. The chair is turned the wrong side up, with the back slanting behind the patient, and the feet in the air. In padding this, as well as an ordinary bed-rest, begin by placing a bolster first, and drawing it round the patient, both to give support and prevent a cold draught coming between the bedclothes and the pillows. Each succeeding pillow is put behind the other.

When a patient is liable to slip down in the bed, it is a good plan to place a pillow under the knees, keeping it in position by

tying tape to the ends, and fastening them to the sides or head of the bed.

In making up a bed for an invalid, first put on the under sheet and pillows, then a sheet of mackintosh and draw sheet, which is simply a sheet folded across the bed, with a piece of mackintosh under, or pieces of calico the size required. These are much easier to change than the large under-sheet, and also spare a great amount of washing, which is a consideration to many. The upper sheet should be brought high enough to fold over the blankets. In putting on the latter, only bring them as high as the patient's neck ; very often they are brought to the top of the bed and folded two or three times over the chest, thus adding to the difficulty of breathing by reason of their weight. The extra length may be folded over the feet instead. Lastly, put on the thin cotton or linen cover, and neatly fold this across the bottom of the bed.

In changing the under sheet, with a helpless patient in bed, the nurse should not attempt it alone, as the patient is sure to try and help. Let two take the clean sheet—one the top and the other the bottom—and roll it lengthways from end to end as far as the middle. Loosen the soiled sheet all round, and roll up one side of it in the same manner, till close to the patient ; then move him gently on to his side, and continue rolling the soiled sheet ; place the clean roll alongside of it, then move the patient on to his back again, and from the other side of the bed move him on to his other side, thus passing over the two rolls. Draw out the soiled sheet, straighten the clean one, and tuck it carefully in all round.

If the nature of the disease or accident is such as will not admit of the patient being moved from side to side, roll up the clean sheet across at the head, bring it down the bed, rolling up the soiled sheet at the same time. First raise the head, then the shoulders and hips. In case of fracture, one should steady the broken limb, whilst the other unrolls the clean sheet and rolls up the soiled one.

To change the upper sheet, remove the cover and the blanket, turn up the soiled sheet and the remaining blanket at one side, then spread over the clean sheet and the other blanket. Tuck these under at the same side that the soiled ones

are turned up; then go to the other side of the bed and draw out the soiled sheet and first blanket. By this means the patient always has a sheet and blanket over him, and there is no risk of giving a chill.

I must apologise for trespassing upon the ground already touched upon by Dr Halliday Croom, in his Lecture entitled "Nursing the Sick," and given before this Society in 1883. The points are of such importance that I feel I should not be justified in omitting them, and it is better to risk repeating what most of you are well acquainted with, than that any should go away in ignorance of the subject.

I have been assisted to-night in my practical illustrations, by Nurses from the Scottish Branch of Queen Victoria's Jubilee Institute for Nurses—an Institute founded by Her Majesty with the Women's Jubilee Offering, to train and provide Nurses to nurse the sick poor in their own homes. The Home in Edinburgh fulfils the double function of a Scottish Training Home, where Nurses are trained, and whence they are sent to districts all over Scotland prepared to support them; and of a District Nurses' Home for Edinburgh, where the number of Nurses retained for Edinburgh will depend on the funds provided by churches and individuals to support them. While not excluding cases of poor patients able to make some contribution, the services of the Nurses are strictly confined to the poor. These Nurses are practical exponents among their patients of the methods I have to-night explained to you, and I heartily wish them and the Institute the success their undertaking so well deserves.

VEGETARIANISM,

AND THE USE OF VEGETABLES IN DIET.

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AT the request of the Health Society I have to-night to lay before you some facts connected with the use of vegetables as articles of diet, and to discuss with you the question of how far it is possible, and if possible, how far advisable, to live exclusively on foods derived from the vegetable kingdom.

It is not my purpose to review the history of vegetarianism, or to investigate the question of whether our remote ancestors were or were not pure vegetarians. These questions alone would afford material for a most interesting lecture. The more practical, and therefore to us the more important, question of the value of vegetables as food stuffs will, however, require for its adequate discussion more than the time at our disposal.

For clearness let me again say that we shall take the subject up under these two heads—

1*st.* What part do vegetables play in dietetics?

2*nd.* Is pure vegetarianism desirable?

But before attacking these questions we must be perfectly sure that we have some sound and definite knowledge on the subject of dietetics generally.

Why do we take food? and why do we select certain articles and reject others? And why do we take the various constituents of our food always in so nearly the same proportions?

LOSS FROM BODY—*A.* MATTER.

You know that we daily lose from our body a certain amount of material. And you must remember that this amount is far greater than ordinary observation would lead us to believe. For besides the matter which everyone is aware of leaving his body, a very large amount is lost in the breath and from the skin.

Under ordinary circumstances about 7 lbs. of matter is lost daily from the body. Now if this were not supplied by the intake of fresh material, the result would be that the body would waste, becoming less and less in weight, till finally death would ensue.

The matter thus lost consists of these chemical elements of which the body is built up. You know that if you take any substance and examine it, you find that it is composed of various simple substances grouped together, and these you can separate one from another until you at length find that you have got substances which can no longer be broken up, and which are therefore called the *chemical elements.* The air of this room, for instance, might be broken up into oxygen, nitrogen, and carbonic acid, while some water would also be present. If we took the carbonic acid we could break it up still further into oxygen and carbon, but we should find it impossible to break these two up any further, and therefore we call them chemical elements. Nitrogen, too, is a chemical element which cannot be broken up. The water we could split up into oxygen and an element called hydrogen.

Now it is convenient, instead of writing the names of these elements in full, simply to write their first letter. Thus—

Oxygen—O.
Carbon—C.
Nitrogen—N.
Hydrogen—H.

By doing this we can very easily write the composition of any of the substances into the structure which these elements enter. Thus the *carbonic acid* which consists of one part of carbon and two parts of oxygen we write—

$$CO_2,$$

while *water*, which is made up of two parts of hydrogen and one of water, we write—

$$H_2O.$$

And so with all other substances.

Now the matter lost from the body consists chiefly of these elements, O, C, N, H, with certain salts, and you might perhaps think that by supplying these in their simple condition we might supply the loss, and in this way provide a truly scientific though perhaps somewhat insipid diet.

B. ENERGY.

This, however, is not the case. The diet must contain something more than matter. It must contain *energy,* or the power of doing work.

This we must try clearly to understand.

USE OF ENERGY IN DOING WORK.

Everyone of us daily performs a certain amount of work, either in walking, lifting and carrying, sawing and hammering, or in a thousand other ways. This is called the *external work.*

Even if we keep absolutely quiet, we cannot stop doing work. Our heart is constantly pumping blood through our body; our chest muscles are constantly drawing air into our lungs, while the muscles of our stomachs and intestines are rarely idle. This we call the *internal work.*

ENERGY IN HEAT PRODUCTION.

At the same time the whole system is being kept warm, for you know that we are much warmer than the air round about us.

It has been calculated that, on an average, a man does every day about as much work as would lift 340 tons to the height of one foot; while at the same time he produces enough heat to boil nearly 50 lbs. of water at the freezing point. Nearly $\frac{9}{10}$ of the energy produced is used for heat production, only $\frac{1}{10}$ for work production.

BODY COMPARED TO MACHINE.

In these respects we are like so many machines—like so many steam engines, which, as you know, not only produce mechanical work, but also produce heat.

Let us see if a study of the work production in a steam engine will help us in understanding the work production in our own bodies.

You all know that the work produced by an engine is due to the burning of the coal in the furnace, and that the more work you want from your engine the more coal you must supply to it. The coal disappears from the furnace. In the process of combustion it is converted to a gas, and this gas passes away from the engine. The engine thus loses matter just as the body does.

But by the burning of the coal—by the change of the coal to this gas—the power of doing work is given to the engine, and this power of doing work we call *energy*.

The energy produced by the burning coals in fact leaves the engine in the production of its work, so that as the coals burn, and the engine does its work, it loses *energy*.

In the engine this loss of matter and the loss of energy are made good by supplying more coals.

Now the human body, we have seen, also does mechanical work. It also produces energy, and this energy leaves the body as well as the matter.

How is a fresh supply of energy to be obtained?

FRESH SUPPLY OF ENERGY.

Plants, like animals, do work. But their work is chiefly in building up their own structure; nevertheless this is often in itself an enormous task. Think of the amount of work required to build up an old oak or giant pine tree! Where do the plants get their energy? They get it from the sun. Light and heat, which are forms of energy, come to the plants in the sun's rays.

But with animals it is different. They have no such source of energy, and they get it from their food.

MATTER AND ENERGY MUST BE SUPPLIED.

So that we now see that the food has to supply not only the matter lost from the body, but also the energy lost, just as the coal of the engine has to supply both losses.

DIFFERENCE BETWEEN MAN AND ENGINE.

So far the resemblance between the human body and the engine is close, but in our further study of this question we shall find that great and fundamental differences exist.

In the first place, to make the supply of energy in the coals available they have simply to be shovelled into the burning furnace. Immediately they ignite, and energy is available for the production of work by the engine.

We cannot, however, in the same way shovel food into a man with the assurance that it will be available for the production of work.

FOOD IN STOMACH NOT *INSIDE* BODY.

A point we must always remember is, that it is one thing to put food in the stomach, quite another thing to get it into the body. You may think this paradoxical, but I would insist that food in the stomach and intestine is just as much outside a man as if it were placed upon his skin. Before the food can be said to have entered the body it must first pass through the walls of these structures.

ABSORPTION OF FOOD FROM STOMACH AND INTESTINE.

Now, at one time it was supposed that this was a very simple matter—that the food had just to drain through the wall, much in the same way as water will slowly drain through a bladder in which it is enclosed.

But we now know that the matter is very much more complicated, and that the whole wall of the stomach and intestine is covered by a number of little living bodies or *cells*, the duty of which is to take up what is suitable and to reject what is unsuitable. Sometimes these cells do not perform their duties properly, and then unsuitable material is allowed to pass, and various forms of so-called *indigestion* are produced.

The cells are, in truth, most thorough epicures, for they are not satisfied with the food in the condition in which it is taken into the mouth. Let even the most skilful *chef* have prepared the meal, these cells will have none of it until it has undergone a further process of preparation in the cavity of the stomach and intestine.

DIGESTION OF FOOD.

Various juices are poured out into these cavities from surrounding structures known as *glands*, and under the influence of these juices the necessary changes occur.

One most desirable quality in a food is that it can be easily and rapidly acted on by these juices, otherwise, before it has been prepared to the satisfaction of the guarding cell it may have been carried down to the lower part of the bowel and expelled.

IN ENGINE, COAL UNCONNECTED WITH ENGINE—IN BODY, FOOD MUST BE PART OF BODY.

There is, however, another and more fundamental point in

which the human body differs from the engine in connection with its supply of matter and energy.

In the engine the coal which is shovelled into the furnace burns there, gives off its energy for the production of mechanical work in the engine, but has never any further connection with the machine. Supply the engine with coal, it will produce work; cut off the supply of coal, no work will be performed.

With the human body, on the other hand, if the supply of food be cut off, the body will still go on doing work. It will use its own substance as a source of energy.

COMPOSITION OF BODY.

Of what is the body composed? We may roughly divide the substances composing the body into living and dead matter.

LIVING AND NON-LIVING STRUCTURES—DEAD PARTS OF BODY.

For all practical purposes our outer skin, our bones, our ligaments, our teeth, hair, and nails, may be considered as dead. They have been formed during our growth, and are retained simply for the support and binding together of the body. They may be looked upon as the hull and spars of a ship, while the living parts of the body may be looked upon as the crew.

CHIEF LIVING PART OF BODY.

The chief of the living parts of the body is the *flesh* or *muscle*, through the activity of which we are able to move about—which, in fact, acts upon the ligaments and bones, much as the crew act upon the rigging of the ship.

We have also the nervous structures of the body which govern the muscles, and which might be compared to the officers commanding our imaginary ship.

A certain amount of living tissue, too, has for its duty, as we have already seen, the preparation of the necessary food for the muscles and nerves. And the food so prepared when in excess of the demands of the muscles and nerves is stored up as fats and as a form of starch.

IMPORTANCE OF MUSCLE.

The muscle is the great work producer. It constitutes no less than 42 or 43 per cent. of substance of body.

Now we have seen that the body even when deprived of food will go on working.

First it will use the stored foods—the starch and fats—as a source of energy, and when these are exhausted, the muscle substance in doing its work uses itself up.

In short, the muscles of the body to produce work require to take various materials into themselves—to make these materials actually part of themselves—before they can get from these matters the energy required to produce work.

If we could imagine an engine which before using its coal first changed it into the steel, brass, &c., which compose the engine, we should have something parallel to the processes which go on in the animal body.

NATURE OF FOOD.

For this reason the food must consist of materials which may be taken up and made part of the muscle.

Now what do we find the muscle is composed of. For living muscle we cannot answer this question, for the moment we begin to analyse it, we stop the series of changes which are going on, and which really constitute its life, and thus kill it, and in doing so we cannot say how far we have altered its composition.

We know that after muscle is killed it is found to be chiefly composed of substances closely allied to white of egg—*albumin.* These are called *albuminous substances,* and they are made up of the chemical elements C, H, O, N, S.

They are sometimes called the "chief substances" (PROTEIDS), because they form such a large part of muscle.

Here is the composition of muscle, so far as its chief constituents are concerned :—

Water	75 per cent.
Solids	25 „
Proteids . . .	. 16-19 „

PROTEIDS NOT USED AS SOURCE OF ENERGY OF MUSCLE.

Are these proteids used up when work is done by muscles? If they are, we should find that various bodies containing their chemical elements would come off from the muscle and leave the body. Among these would be substances containing N. Now

we find that these N-containing substances leaving the body are not increased when the muscles are doing work, or are only slightly increased, and therefore we must conclude that in doing work the proteids are not used as a source of energy, and that any loss of nitrogen-containing substances is simply due to the wear and tear of the apparatus, and might be compared to the steel that is necessarily worn off an engine by friction whenever it is at work.

In fact we may regard these proteids as representing the permanent steel and brass part of an engine. They get worn away, but they are not used as a source of energy.

And just as the steel and brass of an engine must be renewed as it gets worn away, so must these proteid parts of our muscles.

SOURCE OF ENERGY IN MUSCLE.

Where, then, does the muscle get its energy—its power of doing work?

We find that muscle takes up from the blood passing through it *oxygen*, *sugars*, and *fats*. These it seems to build up into its own substance, and then by breaking down to give off the necessary energy for work. The proteids, however, as we have seen, do not under normal conditions break down but remain, and again combine with more oxygen, sugar, and fats.

ENERGY EVOLVED IN MUSCLE COMPARED TO ENERGY EVOLVED IN DYNAMITE.

That the breaking down of such a material as the muscle substance will produce energy, any of you who know about dynamite will readily perceive. Dynamite is simply a complicated chemical substance, like muscle substance, which may suddenly fall to pieces, break up into its chemical elements, and in doing so, as you all know, give off an enormous amount of energy—energy which may be made to do good work, as in mining, quarrying, &c., but which has occasionally been used for work of much more questionable objects.

The muscle then, chiefly composed of these proteids, seems to take up oxygen, sugar, fats, &c., and to make them part of itself. Then it breaks down, and gives energy for work, and the sugar, fats, &c., leave the muscle as the chemical elements of which these substances are built up.

These elements are carbon, hydrogen, and oxygen; nitrogen leaves the muscle only in small amounts.

SOURCE OF ENERGY IN MUSCLE IN STARVATION.

If, however, fat and sugar are not supplied to the muscle, we then find that the proteids *are* broken down and yield the necessary energy. But when this condition has been induced, as in cases of starvation, the fatal termination is always near at hand. Whenever we find that a starving man is beginning to use up the proteids of his muscles to any considerable extent for the production of energy, we know that his state is most critical.

And now we are in a position to see what kinds of food are necessary to supply, not only the loss of matter from the body, but also to supply this energy.

REQUISITES IN FOOD STUFFS.

The three great requisites are :—

1st. The food must contain the chemical elements lost from body.

2nd. These must be in a form which can be absorbed, and when absorbed can be taken up and used by the muscles, etc.

3rd. The food stuffs must contain energy to cover the loss of energy from body.

NATURE OF FOOD STUFFS.

It is found that the foods which fulfil these conditions are those derived from the animal and vegetable kingdom—in fact, foods composed of the same substances as the body itself.

Hence we find that the essential ingredients of the foods are—

1. Proteids (Albumin).
2. Carbohydrates (Starches and Sugars).
3. Fats.

USE OF PROTEIDS.

Proteids are required, *first*, in the adult, to repair the wear and tear of the muscles, just as steel is required to repair the wear and tear of the engine; *second*, in the growing child, in order to build up the muscle and other nitrogen-containing parts of the body, just as steel is required in the construction of the engine.

USE OF STARCHES, SUGARS, AND FATS.

The STARCHES, SUGARS, and FATS may be compared to the coals of the engine. They are required to yield the energy which is to be used either, as in the young animal, in building up the body, or in adults, in the performance of mechanical work and the production of heat.

But remember, that to do this they must first be built up into the muscle substance. They are not merely burned up, as many people believe.

OTHER USES OF PROTEIDS. SOURCE OF ENERGY.

But I must warn you that this mode of stating the question is too general, because proteids may, and in many cases are, used not merely to repair the waste of muscle, or to build up fresh tissues, but also as a source of energy. This occurs whenever the supply of fats and sugars is insufficient, and among some peoples—as among the Mexican rancheros—the food consists almost entirely of proteids.

We shall presently see, however, that this process is a most wasteful and unsatisfactory one, and that it might be compared to working an engine by burning the steel of which it is composed.

POSSIBLE TO LIVE ON PROTEIDS ALONE.

Still remember that it is possible to live on a diet of proteids alone. They may be used both to repair the wear and tear, and also to yield a supply of energy.

NOT POSSIBLE TO LIVE EXCLUSIVELY ON FATS AND SUGARS.

Of course, it is not possible to live entirely upon FATS and SUGARS, because these substances do not contain *nitrogen*, which is one of the important constituents lost from the muscles in their wear and tear.

PROPORTIONS OF FOOD CONSTITUENTS.

This leads us to consider next if it is advisable to take the constituents of our diet in any fixed proportions.

AMOUNT OF PROTEIDS.

It must be quite obvious that, in the first place, enough proteids must be taken to make good all the ordinary waste of the muscle.

Now it is not a very easy thing to say how much of these is required, because it all depends upon how much fats and carbohydrates we can get.

Let us in the first instance suppose that we can get just as much as we like of these substances, how much proteids must we then take ?

The only way to answer this question is by experiment—by trying different amounts of proteids till we find what is the smallest quantity which will prove sufficient to prevent the body from losing weight.

Within the last two years a great number of experiments have been accomplished upon this subject, and, as a result of these, we may conclude that about $1\frac{1}{2}$ ozs. of proteids per diem is sufficient to cover all loss from the body—that is, to repair the wear and tear of the machine.

This, remember, has been found to be about the *minimum* amount ; but in most diets, as we shall afterwards find, the amount of proteids taken is very much greater.

The importance of knowing the smallest amount which is necessary, is that these porteids are the most expensive constituents of the diet.

Further, we find that if the amount of porteids taken be increased, the various chemical changes in the body go on with increased activity, so that more material is thus used. Not only is more proteid material wasted, but more fats and carbohydrates are also changed. Hence, since our object is to work our bodily machine with as little waste as possible, we should avoid large quantities of proteids.

PROTEIDS IN DIET OF CHILDREN.

One point which must ever be borne in mind, however, is that children require a greater proportion of proteids compared to their weight than adults. The reason for this is obvious—children have not only to repair the wear and tear of their muscles, but they have to build up these structures as they grow.

AMOUNT OF SUGARS AND FATS.

Now what amount of sugar and fats are required ?

These must supply the necessary energy of the body, and

therefore one of the questions we must answer is, what amount of energy will a given quantity of each of these substances yield?

This may be determined by burning a given amount, and by ascertaining how much the combustion will heat a given volume of water. In fact, we can in this way find the *heat units* given by any quantity of the substance, and from this we can calculate the number of *work units*—that is, the number of pounds which would be raised one foot, by the energy of the combustion of the substance.

ENERGY YIELDED BY FATS, SUGARS, PROTEIDS.

In this way we find that the energy of one gramme of—

Fats, ...	9300 Calorics.
Sugars, ...	4100 ,,
Proteids, ...	4100 ,,

So we see one pound of fat will yield more energy than two pounds of sugar or proteids.

AMOUNT OF FATS AND SUGARS REQUIRED DEPENDS ON AMOUNT OF WORK DONE.

Now, of course, since these fats and carbohydrates are to yield energy, the amount we require to take will depend on the amount of work we want to do. An individual confined to bed will require very much less than one who has to perform much active work.

In many respects it appears immaterial whether we take in our energy as fats or as carbohydrates. The Esquimaux, for instance, takes it nearly all in the form of fat, the Jap nearly all in the form of sugars and starches.

SHOULD FATS BE TAKEN TO EXCLUSION OF SUGARS?

Since fats are so much more valuable as energy producers, we might be inclined to think that the best plan would be to take fats alone.

To this, however, there are two objections. In the first place, fats are very expensive. In the second place, they are difficult to digest, and therefore if a large amount be taken, a great part is never absorbed with the body, but is simply passed out unused.

SHOULD SUGARS AND STARCHES BE TAKEN TO EXCLUSION OF FATS?

Nor is it advisable to take sugars and starches to the exclusion of fats, because the amount of material which must then be taken to get the necessary energy is so large that the stomach is apt to be overloaded.

The poorer classes in Japan who live almost exclusively upon rice and radishes have to take about 4 or 5 lbs. of these substances per diem to get the amount of energy they require.

PROPORTION OF FATS TO SUGARS.

As a matter of experience it is found convenient to have, if possible, about $\frac{1}{3}$ or $\frac{1}{4}$ as much fats as starches and sugars. But, where expense is an object, the amount of fats may be as low as $\frac{1}{9}$ or $\frac{1}{10}$, without materially interfering with the utility of the diet.

AMOUNT OF FATS AND SUGARS.

From experience we know that if the supply of proteids is small—between $1\frac{1}{2}$ and 2 ozs.—about 20 ozs. of fats and carbohydrates are required.

ALL FOOD TAKEN INTO MOUTH NOT USED IN BODY.

But let me again ask you to remember that it is one thing to put food into our stomachs, quite another to actually take it into our system. We must remember that it has to be taken up from the stomach and intestine by the little cells which line these organs. Therefore, when these cells are acting slowly, or when the food is not in a form suited to their tastes, a part may never be taken into the body, but may simply be passed out of the bowel.

Hence it is usually well in our diet to err on the safe side, and to take rather more than is theoretically required, in order to compensate for any possible loss of this kind.

SOURCE OF PROTEIDS, SUGARS, FATS IN ORDINARY DIETS.

Having now considered what we require to take, let us consider how we may get this from the ordinary articles of diet.

These ordinary articles of diet rarely consist of one of the

ingredients about which we have been speaking, but usually contain two or more.

I have here a number of tables which will show you the relative amounts of proteids, fats, and of carbohydrates contained in various common articles of diet.

I have arranged these in two series—

1*st.* Food stuffs derived from animals.

2*nd.* Food stuffs derived from plants.

ANIMAL FOOD STUFFS.

	Proteids.	Fats.	Carbo-hydrates.	Water.	Salts.
Beef (moderately fat),	20	6·5	0	72·5	1
Herring, . .	18	6	0	75	1
Salt Fish (dry), .	80	1	0	17·5	1·5
Bacon, . . .	5	76	0	14·5	5
Egg, . . .	13	11	0	75	1
Milk, . . .	3·5	3·6	4·8	87·5	0·8
Cheese (fresh), .	25	8	2	62	3

VEGETABLE FOOD STUFFS.

	Proteids.	Fats.	Carbohydrates.		Water.	Salts.
			Digestible.	Cellulose.		
Peas, Beans, Lentils (about), . .	42	2	52·5	5	15	2·5
Oat Meal, . .	12·6	5·6	64	2	13·8	2
Rice, . . .	8	0	76	1	13	1
Potatoes, . .	1·5	0·2	20	1	76·3	1

Now, on looking at these tables, you will see that as regards—

I. Proteids—The animal food-stuffs in most cases contain these in abundance. But you will note that many vegetables also contain them in large amounts.

II. Fats you will see are more abundant in the animal food-stuffs than in the vegetable.

III. Carbohydrates, on the other hand, are much more abundant in the plants than in the animal substances.

USES OF VEGETABLE FOOD STUFFS. SOURCE OF CARBOHYDRATES.

And now you at once see one of the great uses of vegetables in diet—namely, to yield the sugars and starches which we saw were so necessary as sources of energy in the human body.

It is unnecessary for me to draw your attention to the great comparative cheapness of these substances. By using these vegetable products which contain starches and sugars in abundance, we can get the energy we require in the most inexpensive form.

VALUE OF STARCHES AND SUGARS.

I may say that it appears to be immaterial whether these carbohydrates are taken as starch or as sugar. Before either of these can be used in the animal body, it has to be converted into a special kind of sugar, often spoken of as *blood sugar*. With the starches this conversion appears to be somewhat more troublesome than with the ordinary vegetable sugars, and this is especially the case with young children, in whom the structures, or *glands*, which have for their purpose the conversion of starch to blood sugar, are not so active as in the adult individual. For this reason, in dieting infants it is better to select foods which contain sugars instead of starch. Many of the troubles of this tender age would be avoided were this more generally known.

PROTEIDS OF VEGETABLES.

But you see that many vegetables are as rich or richer in proteids than animal food-stuffs. And, therefore, theoretically it should be possible for us to get the necessary quantity of these materials from plants.

CAN VEGETABLE PROTEIDS BE USED ?

The question, however, arises—Can we use the proteids of plants for building up the proteids of the animal body ? May there not be something in these proteids which will render them unsuited for this purpose ?

Chemical examination reveals no difference of importance between the proteids of plants and those of the animal body. But it is quite possible that this may simply be due to the fact that our chemical methods are not sufficiently delicate to detect such differences.

Even though differences did exist, this would not, however, prove that vegetable proteids were unsuitable for the nourishment of animals, because we know that these proteids, under the action of the juices of the stomach and intestine, undergo a profound change before they are taken into the body.

We have, however, good evidence to show that vegetable proteids are perfectly adapted to repair the waste, and to build up the muscles of animals—for we know that many kinds of animals get the proteids necessary for this purpose exclusively from plants. Of these animals it is only necessary to mention the cow and horse.

The most satisfactory way to answer the question, however, is by experiments. And such experiments have recently been made to determine the question not only whether plant proteids may be used in building up and repairing the muscles of man, but also whether they have the same value for this purpose as animal proteids. These experiments were performed by a German doctor and his wife.

They put themselves on a fixed diet containing animal proteids, and after a given time substituted vegetable proteids for these, leaving the other constituents of their diet unaltered, and they found that the vegetable proteids were in all respects as useful as those derived from an animal source.

VEGETABLE PROTEIDS AS USEFUL AS ANIMAL PROTEIDS.

We thus see that vegetable proteids are just as useful as animal proteids in repairing the wear and tear of the body of man.

ABSORPTION OF ANIMAL AND VEGETABLE PROTEIDS.

But, while considering the relative value of proteids derived from these two sources, we must take into consideration another and most important factor.

Granting that the two kinds of proteids when once absorbed into the body are of equal value, do we find any difference in the ease with which they are prepared in the stomach and intestine and absorbed from these into the body. Such a difference if it existed would of course necessarily have a marked influence on an estimation of the relative value of the two substances.

MODE OF OCCURRENCE OF PROTEIDS IN PLANTS AND ANIMALS.

We find that the proteids both of plants and animals are for the most part contained in small masses or *cells ;* and when we examine these cells with care we find that in plants they are covered by a strong firm capsule composed of a substance known as *cellulose.* This is tough, and when introduced into the stomach and intestine of man it is practically not acted upon by the juices. Hence you see that unless these cells are in some way broken up so that the juices can get at the proteids contained, we cannot have these acted upon and absorbed from the stomach. They will simply be passed out of the bowel.

By various methods of preparation—as in the grinding of meal and flour, and still more by the process of mastication, in which the teeth break up the coverings of the cells—these proteids are exposed to the action of the digestive juices, and are thus prepared for absorption. They are not, however, absorbed so completely as the animal proteids.

In animals, on the other hand, the cells which contain these proteids are either destitute of a covering, or the covering is composed of a substance which is readily dissolved by the action of the juices of the stomach.

Hence these animal proteids are more easily taken up from the stomach and intestine, and there is thus less chance of their passing through the intestine unused.

For this reason we must consider them as more valuable food-stuffs than those derived from vegetable sources.

VEGETABLES AS A SOURCE OF FAT.

When we come now to consider the vegetables as a source of fat, we at once see that in this ingredient they are nearly all very deficient.

But you all know that certain vegetables are very rich in oils, and that these vegetable oils—especially olive oil—are largely used in the diet.

USE OF VEGETABLE FATS IN BODY.

We must therefore consider in how far these vegetable fats —for oils are simply fats fluid at the ordinary temperature—are of use in the body.

We may consider this under the following heads :—

1*st.* Are they as easily digested and absorbed as the animal fats?

2*nd.* When absorbed are they of value as sources of energy?

3*rd.* When absorbed can they be stored up in the body as reserve material?

1*st. Are they as easily digested as animal fats?*

As a general rule we may say that they are not. Many vegetable fats when taken into the stomach and intestine are not absorbed, but irritate the bowel and produce purgation, by means of which they are got rid of. This is well seen in the case of castor oil, but also is frequently to be observed with ordinary olive oil. With certain individuals, however, these vegetable fats seem to be very easily absorbed, and I have known patients who could not absorb the most digestible of animal fats—cod liver oil—and who yet could take and absorb enormous quantities of olive oil.

However, speaking generally we may say that the vegetable fats are not so easily absorbed as the animal fats.

2*nd. Are they, when absorbed, of value as a source of energy?*

About this there can be no doubt. These vegetable fats when absorbed are used up, built into the muscle, and then broken down, just as are the fats derived from animals.

3*rd. Can they be stored in the body as reserve material?*

You know that the fats of different animals differ from one another. The fat of the sheep, for instance, forms a white hard mass at the temperature of the room, while the fat of the dog remains semi-fluid at the same temperature. At the temperature of the body all the fats are semi-fluid. Now this difference in the consistence of the fats depends upon a difference in their composition. Every piece of fat is really a mixture of three kinds of fats, and if one of these is in abundance the fat is hard and not easily melted, while when another is in excess it is fluid. Each animal seems to have its fat composed of a definite proportion of these different fats.

And now arises the question, This being so, will the animal, when fed upon any special kind of fat, be able to convert it into its own fat, or will it be stored up in place of the animal's own fat?

This is a question of great importance to the farmer who has

to fatten animals for the food market, and it is also of importance in the fattening of consumptive patients with cod liver oil.

A great many experiments have been made on the subject, and these tend to show that fats, from whatever source, are taken up and directly stored in an unaltered form in the animal body.

Thus, pigs and oxen fed on oilcake are apt to have a fat very much more fluid than the fat nominally occurring in these animals, while there can be little doubt that the fat laid on by patients treated with cod liver oil is not the same firm fat as usually occurs in man.

We thus see that vegetable fats can hardly be considered as so suitable for the nourishment of the body as the animal fats.

PHOSPHORUS AND SULPHUR OF FOOD.

But I must tell you that in addition to these three substances —proteids, carbohydrates, and fats—phosphorus, sulphur, iron, and various salts are necessary for the nutrition of the animal.

Without phosphorus and sulphur it seems impossible to have living matter. They are just as essential for the lowly mould as for the most perfectly developed man.

It is impossible here to enter upon the very interesting question of how these are supplied to the body. Suffice it to say that they must be taken in organic combination—that is already combined with proteids, and that they may be got as readily from vegetable as from animal food-stuffs.

PART PLAYED BY VEGETABLES IN DIET.

And now what practical conclusions can we draw in regard to the part which vegetables should play in diet?

In the first place, we have seen that carbohydrates are practically essential constituents of our food, and since these are contained in abundance in vegetables, and are practically absent from animal foods, we naturally must use vegetables largely in our diet.

IMPORTANCE OF COOKING.

Now in order to make the sugars and starches contained in vegetables as easily absorbed as possible, it is well to have them thoroughly cooked. Unless this is attended to, much of the vegetable matter will simply be carried right through the bowel.

IMPORTANT ACTION OF CELLULOSE ON BOWEL.

There is one carbohydrate constituent of vegetables to which I have before alluded—namely, CELLULOSE. You remember that this forms the covering of the cells of which plants are built up, and you remember we saw that its presence retarded the utilization of the proteids which plants contain.

Has this cellulose no use in digestion? I may tell you that it has a most important use—a use which should be much more fully recognised.

The presence of this indigestible substance acts as a stimulant to the bowel, and if foods carefully deprived of cellulose be employed, a sluggish condition of the bowel is always produced.

Hence for this reason, in selecting the vegetables which are to yield the necessary quantity of carbohydrates, we do not always choose those in which the starches and sugars are in their purest condition. If we attempted to take our carbohydrates as pure sugar or arrowroot, the bowels would soon get out of order. We should be careful to select a source containing a certain quantity of this material, unless, of course, the bowels are in an irritable condition, when we as carefully avoid those substances which contain much cellulose.

Among foods which contain a large amount of this, I may mention peas, beans, oatmeal, brown bread, and the various green vegetables; while, on the other hand, rice, flour, sago, tapioca, &c., contain very little.

So much, then, this first and chief use of vegetables. They are the great source of sugars and fats.

VEGETABLES AS SOURCE OF PROTEIDS.

2nd. They may be used as a source of proteids—as a source of the materials required for repairing and building up the muscular substance.

In their raw and unprepared condition we have already seen that, unless thoroughly well triturated with the teeth, vegetables do not readily yield the proteids they contain.

When properly prepared and carefully cooked, on the other hand, they form, for those with a sound digestion, a most valuable source of proteids. Especially is this the case with the various pulses—peas, beans, lentils, &c.

Roughly speaking, an ounce of these contains as much proteid material as one ounce of beef, while it costs only a very small fraction of the price.

Oatmeal, too, contains, you see, a fair proportion of proteids—one and a half ounces coresponding to one ounce of beef.

Remember, however, that these vegetable proteids are not so completely absorbed as those derived from animals.

VEGETABLES AS SOURCE OF FATS.

3rd. We have seen that as sources of the necessary fats, vegetables must always rank far below animal foods.

IS VEGETARIANISM POSSIBLE ?

And now let me consider the question, Is it possible to live on vegetables alone ?

THEORETICAL CONSIDERATION.

If you will recall what I have already told you, you will see that, theoretically, it is perfectly possible.

From vegetables judiciously selected and prepared we can get the proteids, carbohydrates, and fats necessary for our nutrition.

PRACTICAL CONSIDERATION.

Is vegetarianism practically possible ? Undoubtedly it is. It is perfectly possible for anyone with a good set of teeth, a sound digestion, and a knowledge of dietetics, to be a vegetarian. In addition to this he should be familiar with the proper methods of cooking vegetables.

DIGESTION MUST BE GOOD.

In the first place, a healthy digestion is necessary, because, as we have already seen, it is by no means so easy for the stomach and intestine to prepare and absorb the necessary materials from vegetable as it is from animal food-stuffs. And for this reason, when there is any weakness of the digestion, a purely vegetable diet is not desirable.

On this account it follows that vegetarianism is more adapted to the robust out-door labourer than to the dweller in towns.

TEETH SHOULD BE SOUND.

Again, if vegetarianism is to be followed, the teeth should be in a good condition. Without good teeth good digestion is impossible, and especially is this so with a vegetable diet. For, unless the food is properly triturated by the teeth, the juices of the alimentary canal cannot prepare the proteids which are contained in their cellulose capsule. Of course by judicious preparation and cooking, the necessity of trituration by the teeth may be minimised.

For this reason peas meal is much more easily used than ordinary boiled peas, while the boiled peas are again better than raw peas.

This is a fact which the would-be vegetarian is apt to ignore. I remember being once called in to see a young woman who had fainted, and found she had been in reduced circumstances, and having heard that lentils contained a large quantity of nourishing substances, had attempted to subsist upon these in an uncooked condition. The result was that she was rapidly starving to death.

KNOWLEDGE OF DIETETICS NECESSARY.

This leads us to consider the last and most important point. A knowledge of dietetics and of the proper methods of cooking vegetables is necessary for the vegetarian.

He must know what elements his food must contain, and he must know from what vegetables these may best be got. The usual idea of a vegetarian is a man who lives exclusively on cabbage, with perhaps an occasional turnip or carrot by way of variety. And many would-be vegetarians have starved themselves on such a diet, and have come to the conclusion that vegetarianism does not suit *them.*

VEGETABLES OF LITTLE USE.

A vegetarian must remember that a large number of vegetables contain so much water and so much of the useless cellulose material of which I have already spoken, that in order to get enough proteids and carbohydrates he must overload his stomach two or three times a day, and suffer all the disagreeable symptoms of repletion.

There used to be an idea that the Irish labourer subsisted on potatoes alone, but when we think that in order to get from these the necessary amount of nourishment he must have eaten no less

than ten or twelve lbs. a day—a feat which would have taxed Gargantua himself—we must refuse to believe this statement.

No reasonable being would attempt to get his nourishment from the green succulent vegetable. These are pleasant and useful additions to an animal diet, but cannot be regarded as food, stuffs suitable for a man of ordinary gastric capacity.

USEFUL VEGETABLES—QUESTIONS TO BE CONSIDERED.

1. *How to get Proteids.*—In deciding on what vegetables must be used, the first question to be considered is, how are we to get 2 or 3 ozs. of proteids ? With vegetables we must be well over our theoretical figures, because we must remember that much of these vegetable proteids are not absorbed.

To supply this we should select some vegetable food rich in proteids. Peas, beans, and lentils occupy the first rank among such vegetables, while oatmeal, flour, &c., come next.

One ounce of proteids may be got from—

Beans	4 oz.
Peas	$4\frac{1}{4}$,,
Oatmeal	$6\frac{1}{2}$,,
Rice	$12\frac{1}{2}$,,

2. *Carbohydrates.*—With the carbohydrates we have no difficulty. An ounce of pure sugar or starch may be got from—

Ordinary sugar, about	. .	1 oz.
Rice	,, . .	$1\frac{1}{4}$,,
Oatmeal	,, . .	$1\frac{1}{2}$,,
Peas	,, . .	2 ,,
Potatoes	,, . .	5 ,,
Cabbage	,, . .	20 ,,

3. *Fats.*—One great difficulty with vegetables is to get a proper supply of fat.

If an individual decides to be a complete vegetarian, olive oil may be used, but he will be wiser to modify his vegetarian habits, and to utilize butter, suet, and lard as sources of fat.

A vegetarian would find that his wants would be fully supplied by the following diet :—

Breakfast.—Oatmeal porridge, with suet or butter or milk ; cocoa or tea, bread and butter.

Dinner.—Pea soup ; beans, dripping, or lard ; sago, tapioca, or other pudding, with or without milk.

Tea.—Bread and butter, cocoa or tea.

I do not here give definite quantities, because what is necessary for one man is too much for another, and, fortunately, our appetites are admirable guides as to the amount we ought to take.

In regard to the cooking of vegetables, I do not feel myself competent to speak.

The object to be kept in view is to combine the vegetables so as to give the necessary food ingredients in their proper proportion, and, at the same time, to vary the combinations as much as possible, and to render these palatable. For there can be no doubt that the activity of digestion is markedly influenced by the flavour of the food. Remember, too, in cooking vegetables their poverty in fats, and supplement this largely by the judicious use of butter, lard, and oil.

DIFFICULTIES OF VEGETARIANISM.

Two great difficulties have to be encountered in any attempt to introduce vegetarianism into this country.

In the first place, vegetables are not cultivated so carefully as they should be.

In the second place, the cooking of vegetables is not understood. In France and Italy one may live admirably, for a short period at least, as a vegetarian, and even in London, in many restaurants a by no means unpalatable vegetarian *menu* may be obtained. But north of the metropolis vegetarianism is in its infancy. Whether it will ever come to anything more we cannot say.

I am no champion of an exclusively vegetable diet—I entirely fail to see its advantages. But I cannot but feel that, among the poor classes especially, the use of vegetables in diet is sadly ignored, and that much money is needlessly squandered on flesh food, with the idea that it is strength-giving, or simply because ignorance and prejudice prevent the acceptance of the teaching of physiology, which shows so clearly that the cheaper vegetable food-stuffs are, in many respects, of equal value with the more costly animal products.

PREVALENT POPULAR IDEAS AND ERRORS ABOUT THE EYE AND ITS DISORDERS.

By GEORGE A. BERRY, M.B., F.R.C.S.Ed.,
OPHTHALMIC SURGEON, EDINBURGH ROYAL INFIRMARY.

PREVALENT POPULAR IDEAS AND ERRORS ABOUT THE EYE AND ITS DISORDERS.

By GEORGE A. BERRY, M.B., F.R.C.S.

When I was asked to give you a health lecture on the eye, I must confess that my first feeling was that anything I could say to which such a title might appropriately be given could hardly at the same time be very popular. The views entertained by different oculists of experience as to the cause and prevention of many of the disorders of the eye vary greatly. Some special knowledge of the whole subject would be required in an audience before whom such points were discussed. This, at all events, would be the case were I individually to attempt anything of the kind. For any one who has a hobby it is easy, no doubt, to popularise the most obstruse subject. But, unfortunately, I am not aware that on questions to which I am now referring I have any hobby. If we were, on the other hand, to leave out the "Health" and merely consider the subject for lecture to be "The Eye," there is hardly any end to the number of themes, speculative, scientific, and even practical which might be more or less easily popularised. Here the main difficulty would be to make a selection. I have, however, more as a matter of duty, than from any feeling that what I shall have to say can afford you any amusement, chosen a subject which I think may reasonably be called a health lecture. I will ask you then to bear with me for some time while I tell you something as to "Popular ideas and errors in connection with the eye and its disorders."

We all know that by constant overwork of any part of the body that part becomes weakened and less able to perform its

functions. Thus it may be the stomach, the limbs, the brain. Evidences of overwork of these organs are familiar to most of us. The balance may in every case be only temporarily disturbed and the normal conditions be restored by rest. For each particular organ rest is, of course, to be obtained in some special manner. This is almost self-evident. What is rest to the limbs is not necessarily rest to the stomach or brain. On the other hand the changes brought about by overwork may be more or less serious to the particular organ itself, or through it to the body generally. It is natural to suppose, therefore, that overwork will also cause either temporary or permanent disorder to the eyes. But it is very difficult to say what constitutes overwork in the case of healthy eyes. Just as a healthy young stomach can digest almost anything and healthy young limbs perform the most astonishing feats without harm, so healthy eyes, not necessarily young eyes, can do any amount of work under normal conditions. It is certainly bad for the eyes to work either in too feeble or too powerful an illumination.

The popular idea, however, of the extent to which overwork hurts the eyes is somewhat exaggerated. It is common to hear such a remark as "I know I spoilt my eyes by too much sewing," or "too much reading," and to find that either there is nothing actually wrong or that there is some defect or some disease which can in no way be connected with the use of the eyes. Many people start with conditions unfavourable for the use of the eyes, at all events for near work, which they nevertheless have to do. The consequence is that the work is done with much greater difficulty and gives rise to much greater fatigue than in others more fortunately situated. This fatigue, it may be, is only felt after a considerable length of time, and then, naturally enough, is ascribed to overwork, and not to the unfavourable conditions of which the individual is as a rule unconscious. Thus the eyes may have been *out of focus* to begin with, but in such a way that by an increased effort they can be focussed properly; that is to say, there may be an optical error capable of being overcome by an effort. This is the case in what is called *long sight.* Long sight is so common that this, and the fact of its being capable of being corrected by an unconscious muscular

effort, give rise no doubt to the popular idea of overwork damaging the sight. The effort can be kept up for some time, but a time comes when this proves to be too great a tax—the effort is relaxed, and as a consequence sight becomes indistinct. As time goes on this inability to prolong indefinitely the muscular effort necessary for correcting the long sight more frequently shows itself. One reason for this is that as one gets older, the power of correcting the defect becomes less. Another reason is that, although the constant necessity for making the effort to correct the focus leads gradually to a greater facility in doing so, still in many cases, unless the individual happens to be in vigorous health, this is attended by considerable difficulty. To maintain any effort for any length of time requires, of course, a certain degree of vigour. Hence we find that the difficulties of a long-sighted individual begin to show themselves when he is tired. They are often therefore not experienced until the evening, after a day's work, when at the same time the illumination is bad. Whereas, on the contrary, in the morning, after rest or at any time when the light is very good, they are hardly at all noticeable. To remedy this particular defect glasses are required. In this manner by giving the muscular mechanism within the eyes less work to do the indication for rest is complied with, so far at all events that in most cases the individual is able to use his eyes with the same comfort as others who are far more favourably situated with respect to the focus of their eyes.

One often hears people say that those who are *short-sighted* have this advantage over others, that their eyes go less rapidly when they are old, or, as it is often put, "last longer." This has reference not to any actual disease which is supposed to overtake the eyes as one gets older, but to the necessity for wearing spectacles for reading or for doing any work near at hand. All people who have had good distant vision and have not been long-sighted, that is to say, in the sense of having an optical defect of the exact opposite nature from short sight, experience the necessity some time between forty-five and fifty of using spectacles for reading. Other things being equal the time when they have to be begun differs within about these limits according to whether or not the individual is in the habit of reading much or of occupying

himself much with any other kind of fine work. This aid is necessary, because at that time of life it has become impossible to get a clear image of anything lying within a certain distance from the eye. Things have to be held further off. The difficulty is usually felt in reading at night, because, as a rule, the illumination is then so much less powerful than by daylight, that in order to see anything as well it must be held closer to the eyes, and this is just what old people with old sight cannot do. This necessity for wearing glasses as one gets older is no more a disease, however, than it is a disease to be fifty instead of twenty. It does not mean that the eyes are going in the sense that the vision has become less acute. The eye has lost, it is true, to a great extent, its power of accommodating itself for different distances, but this has been going on, and must of necessity go on, throughout life; it is only at about the age of forty-five, or a little later, that the inconvenience of this is felt. Now, in those who are short-sighted the same inconvenience is felt at a later age; and indeed, if the short sight is moderately high, it may never be felt in the same way at all; that is to say, such individuals may never require old sight spectacles. This, however, is a very different thing from having stronger eyes or eyes that "last longer" or "go less rapidly." Some short-sighted people have anything but strong eyes, in the true sense, and even when their eyes are, as is the case in the great majority of instances, quite healthy, their position in respect to spectacles is not, after all, so enviable a one. In fact they must either go about without seeing things beyond a certain distance distinctly, or wear spectacles more or less constantly for distance. If, then, they have the advantage of being able to do without old sight spectacles, they have had the disadvantage of wearing spectacles for the best part of their life more or less constantly, or of having to be satisfied with an imperfect and more or less hazy view of surrounding objects. This questionable advantage is no doubt the one which gives rise to the popular idea that the short-sighted eye gets stronger as one gets older—and lasts longer. But there is in addition a real change for the better, as far as the degree of short sight goes, which takes place in old age, and no doubt this accounts for some of the popular ideas regarding the advantages of the short-sighted individual. A

certain degree of the short sight really often disappears, if it be moderate in amount, after sixty, so that in cases of slight degrees of short sight it happens that the distant vision actually improves with age. I have not, however, found that it is a great consolation to people of twenty or so to be told that their short-sight will likely be less or may even disappear when they get beyond sixty. When people on the other hand have to begin spectacles sooner than about forty-five, they usually think of themselves, or are encouraged by their friends to think that their eyes are going rapidly, giving way in fact, whereas in reality they are merely long-sighted to begin with. Their starting point as regards distant vision is the opposite of the short-sighted one.

The natural optical defects of advancing age, to the main one of which we have just been directing our attention, are evidently expected by some people to be much more considerable than they really are. Some people, therefore, even when they have some real and more serious disorder of the eyes are more or less resigned to it on the score that it is "just old age." No doubt diseases are more common in old age, but we cannot call the invariable and necessary changes of old age diseases; so that it is not strictly correct even in the case of an actual disorder of a nature only met with in advanced life, to say that the defect of vision is "just old age." Such a vague diagnosis however would satisfy many people. When there is nothing to be done, it is in such cases perhaps a pity to disturb the feeling of resignation to which this vague diagnosis often gives rise by letting it be known that what is, need not have been.

Some people are fond of vague diagnoses; many for instance are quite satisfied to think that they have *weak eyes.* That is an expression which seems to convey much more to the patient than it does to the oculist. It stands for any defect of vision, either optical or other, for watering of the eyes, for pain, for inability to face the light comfortably, &c. If we ask a patient what he complains of, we are just as likely as not to get the answer "weak eyes."

From what has been said with reference to old sight, I think it must be evident to you that the name "preserves" so commonly applied to old sight spectacles, is one which is founded on a

popular error. Such spectacles help the vision by enabling the eye to see what would otherwise be invisible, or only seen with difficulty, but they no more preserve the sight than do telescopes or microscopes.

The remark is frequently made, "I am afraid," or "I know I have spoilt my eyes by wearing spectacles." Before proceeding to inquire what it is that has probably given rise to this idea, one which is so prevalent that it may certainly be called a popular idea, let me say that the wearing of spectacles specially suited to otherwise healthy eyes, can never do any harm; indeed it is very doubtful whether even unsuitable spectacles, however much discomfort they may cause, ever do any real harm. In a few cases certainly this may tend to favour the development of a squint, but I am now referring to the actual "spoiling" of the eyes by bringing about changes which diminish the sharpness of vision, or cause any permanent interference with the normal manner in which the eye is able to perform its functions. I do not wish by this to imply that no care should be taken in the selection of proper glasses—far from it—but merely to point out that the spectacles are often blamed for what has in reality nothing to do with them. Some diseases come on slowly, and if the defects which they produce happen to assert themselves shortly after spectacles have been begun to be worn, the spectacles very often get the blame. This is not unnatural; the true cause is not, and cannot be, appreciated by the individual, and he consequently looks no further for it. From the spectacles to the man who ordered them is only a step; so that it often happens that the oculist is blamed too! In such cases as those to which I have now referred it is evident that it is only an inference that the glasses have actually proved hurtful, but there are other cases where even the more critical might easily be misled. For instance, it often enough happens that an individual wearing spectacles for reading, experiences a great deal of discomfort or actual pain shortly after he has put them on. He then takes them off and soon the pain disappears. When he has noticed this several times he may not unnaturally come to the conclusion that his spectacles are at fault. But he forgets to try to read without them, or if he cannot do so, he forgets that when he is

not reading his pain goes away. It does not occur to him to blame the use of the eyes for near work independently altogether of the spectacles, which in many cases, especially where some superficial inflammation of the eyelids exists, is the true explanation of his difficulties.

One explanation then for the belief that the eyes have been spoilt by spectacles is that an altogether independent condition may be connected in the imagination of the individual with the use of his spectacles. Another foundation for the same belief is this: after suitable glasses have been worn for some time the acuteness of vision may not be, and usually is not, if the glasses have been constantly worn, as good without them as it was before their aid was called in. This arises in the case of the short-sighted individual from his soon losing the habit of making so much out of the bad images which his unaided eye gets of distant objects as he did before the use of the correcting glasses has accustomed him to sharp distinct images. He therefore notices when he takes them off that he cannot make out so much with the naked eye as he did before.

In the case of the long-sighted the same difficulty may arise owing to the disuse of the effort by which they were in the habit of correcting their optical defect before the use of spectacles rendered this unnecessary. In both cases the former degree or acuteness of vision returns when the glasses have been laid aside for only a few days. But this is rarely done, as the disadvantage of having less sharp vision without spectacles is much more than counterbalanced by the distinct and more comfortable vision which the correcting glasses afford in each case.

One more remark about spectacles. There is a popular idea, which the opticians evidently find it to their interest to keep up, that pebble spectacles possess very important advantages over glass ones. This is a mistake; the only advantage is that they do not get scratched. In the case of very strong glasses, such as are required after an operation for cataract, they may possibly sometimes be more comfortable owing to their being less pervious to heat, and therefore cooler. I am inclined to think, however, that this advantage is more imaginary than real—at all events it has lately been shown that the peculiar irritation of the eyes

which is produced by strong light falling on them, as *e.g.*, in snow-blindness and electric light ophthalmia, occurs more easily if the light reaches the eye through crystal than if ordinary glass intervenes. This is owing to the fact that certain rays are more readily transmitted through crystal than through glass which more completely absorbs them. In this connection let me just tell you of a marvellous provision of nature. It has only recently been proved that these rays of light which are most active chemically are the ones which most seriously damage the delicate light-perceiving structures of the eye when it is subjected to too strong a light. Some of these chemical rays are actually invisible, and can only be called light rays because they are of the same nature as those which give rise to an impression of light. Now it has long been known that such rays are to a great extent absorbed by the transparent portions of the eye, especially by the crystalline lens. There is in the eye itself, then, an arrangement which, to a great extent, protects it against the effects of too strong light.

Popular ideas as to the cause of *squinting* are very numerous. Some of these are founded on fact, some purely imaginative. Thus one of the commonest ideas is that squint is imitative; some other members of the family, or, it may be, someone else often seen by a child, squints, and the child has learnt it from them. Or again, it has had a pimple or some other mark on its nose, and has amused itself by studying this until the eyes have remained in the squinting position. With the natural tendency to which I have already referred to find an explanation for everything, it is not surprising that one should hear many causes given for squint, as it is extremely rare that the squint exists at birth. Something must have brought it on, and it only depends on the greater or less imaginative power of the parents what it will be ascribed to. It would take too long to explain what is the real cause of squinting; suffice it to say that it is almost always the result of long-sight, where there are at the same time other conditions favourable, the main one being defective vision in one eye. The reason why it comes on generally after the first year or two of life is that the conditions are most favourable for its development when the child begins to look much at near

objects, and because a certain time must elapse before the squint becomes permanently established. A favouring circumstance in a good many cases is inflammation of the one eye, which is common in delicate children after measles, &c. The inflammation temporarily interferes with the vision of the eye, and when the other conditions are favourable a squint may be established before the eye recovers. In these cases the connection up to a certain point is seen by the parents. As much the same optical conditions are apt to exist in several members of the same family it is not extraordinary that more than one should often squint. But it is also not extraordinary that this should give rise to the imitative theory, and that the so-called "bad habit" should be taken up by Johnnie from Tommy or Maggie. The optical conditions which are at the real root of the matter are not apparent, and, indeed, it is not so long ago (just about thirty years) since they have been understood at all.

The popular errors with regard to spectacles and squinting—with regard, in fact, to sound, but possibly optically defective, eyes—are of little consequence, as they seldom do any great harm, at all events as far as the eyes themselves are concerned. I have now to speak of some popular errors which have more or less serious consequences, viz., *errors of treatment* in cases where there is really something wrong. A certain number of people are always ready to give advice—people who believe there must be a cure for everything, and who, unlike the quack doctor, think that every separate complaint, as far as they can distinguish between them, calls for some different treatment. Old women are the principal sinners in this respect; they are as fond of doctoring as they are of scandal. It is a pity only that their good intentions should so often do harm. And harm they really do; much more than the quack doctor, who usually takes care that the medicine which he vaunts for the cure of every possible and impossible disease shall at least be harmless. He trades on the principle of non-interference; but, at the same time, in order to make this pay, he takes advantage of the credulity of the public, who do not appreciate non-interference. The result is that nine times out of ten at least, he "cures" his clients. He does evil that good may come—to himself—and good comes to others too.

This principle of doing nothing, and yet making yourself or your patient believe that you are doing something, a principle which every conscientious and properly trained physician will hesitate to adopt, is yet one which is often beneficial from a medical point of view. It is the real, if not the acknowledged, principle of homœopathy, the one to which that system owes its success. Indeed, it is not unlikely that if homœopathy had been introduced sooner, medicine would have been further advanced to-day than it is. As there would have been greater opportunities of studying disease in its natural course, not as modified by more or less harmful treatment.

Much of the modern advance made in medicine and surgery is due to the recognition of the fact that the most successful treatment consists in adopting the simplest means which favour the natural healing processes. To no organ does this apply more than to the eye. A very common mistake is to suppose that when an eye is injured, or has begun for any reason to inflame, it should at once be *poulticed*. Wet cloths or poultices are applied to "draw out the inflammation." This expression is one which conveys apparently more meaning to the public generally than it does to the doctor. But let us see what poulticing really does. It tends to promote suppuration, or, in popular terms, "to bring the inflammation to a head." Now what is much more indicated in the case of inflammations of the eye, is to restrain the inflammation. No doubt dry or moist heat is useful in some deep inflammations of the eye; but, as a rule, poulticing should be avoided; it often does a very great deal of harm. For instance, whenever there is an ulcer on the clear portion of the eye, the cornea, poulticing is almost sure to make it extend. In some cases this happens with very great rapidity, and the result is that the eye is destroyed altogether, or to a great extent deprived of its sight. The cases where this happens are generally cases in which the eye has previously been a "watery eye," and has been injured by a piece of metal, or coal, or other substance. In the case of any *injury* to the eye, at all events, the individual should lose no time in getting proper advice, as, even in very slight superficial injuries, proper attention to cleanliness is of the utmost importance. No doubt the reason why poulticing has come to be a popular

remedy is that it gives relief at the time; sometimes very considerable relief. The application of heat for a short time often, indeed, does good, and even a poultice may frequently not only relieve pain, but favourably influence and tend to check the inflammation. It is the repeated use of poultices for several days and nights in succession that is apt to do so much harm; and, indeed, poulticing is altogether too dangerous not to be condemned, at least in the hands of any one who has no special knowledge of eye-diseases.

Another popular remedy for "inflamed eyes" is *cold tea.* This is a mild astringent, and is certainly not out of place in some chronic forms of inflammation of the lids, but the fault in its popular application lies, in the first place, in its being used in the wrong cases, and secondly, in its being used in the form of wet cloths kept applied to the eye—in fact, to poulticing with infusion of tea, which is, perhaps, a shade worse than poulticing with a simple non-irritating substance.

There are a great many different forms of inflammation of the eye, some of which are serious even when not interfered with, others not. In the popular mind they are all classed, at least these which produce visible external symptoms of inflammation, under the one term of "inflamed eye," and hence any remedy which proved useful when so-and-so had an inflamed eye is at once used for the next case of inflamed eye. The result is, that whereas in one, or even in many cases, the treatment may have done no harm, or actually, let us say, done good, it may prove, in a particular case, ruination to the eye. The best rule to be guided by is to do nothing except attend to cleanliness where the inflammation is acute, that is to say, where it has come on in an eye previously well, and take the first opportunity of getting advice.

Just a few words as to what is meant by attending to cleanliness. Where there is any discharge from the eye it should not be allowed to be retained in the eye by some of it drying on the eyelids and gluing them together as one so often sees; it should be removed, and removed with something clean, not with a dirty cloth such as is frequently used for the purpose. Care must also be taken that any of

the discharge does not get into the individual's other eye or into anyone else's eyes. All this may best be done by frequently bathing the eye with some tepid water which has been poured into a clean dish from the kettle and allowed to cool, using for the purpose a small piece of clean rag or sponge (or better still, some absorbent cotton wool), which must be burnt immediately after use. A little fresh lard or fresh butter smeared along the margins of the lids prevents them sticking together; this should be done at night.

I shall now in this connection only refer to two remedies used for "inflamed eyes" which ought to be altogether condemned for popular use, viz., *sulphate of zinc* and *lead lotions.* It is a common enough thing, fortunately not so common now as it used to be, for any one with inflamed eyes, at the advice of some kindly "old wife," to buy from the druggist a pennyworth of sulphate of zinc, mix it with a pint of water, and use it as an eye-wash. Now, apart from the fact that this is often used in the case of deeper inflammations where it does no end of harm, it is altogether a mixture of very varying strength, as the amount of sulphate of zinc is not a constant quantity, but depends greatly on the good nature of the druggist. The practical result is often that, even in cases where this substance would do little harm if used in sufficiently weak solution, it is more or less powerfully irritating in the pennyworth to the pint strength. As to the other it would be a good rule to remember never to use lead lotions of any kind for inflamed eyes without getting proper advice. Although lead lotions differ from sulphate of zinc lotions in this respect, that in suitable cases they really appear to be of use, still in some cases they may do even more harm. They leave, in fact, where there is any ulceration of the eye, a white deposit in the clear part of the eye or cornea, which may greatly interfere with vision, and which can rarely be satisfactorily removed.

I have now to make a few remarks with reference to *tying up and shading the eyes*, or keeping any one with bad eyes in the dark and indoors. There are popular beliefs on these points which it would be well to have shaken. If one asks why an eye is tied up, the answer almost invariably given is "to keep the cold out."

This seems natural and rational enough, and yet it is a fact that tying up is in most cases injurious. It is better to avoid it, as it tends to keep the secretions retained in the eye. This is a far greater source of danger than exposure to the air. Indeed, as a rule, there is not much tendency to catching cold in an eye which is already inflamed. In cases where there is, it is very doubtful if the tying up does much good in the way of preventing cold; at all events it should not be done to the neglect or the protection of the rest of the body. In children the rule I should recommend you to follow is never to tie up the eyes unless specially ordered to do so. I need hardly say further that, at all events, if the eyes are tied up, the material used for doing so should be clean and frequently changed. A great deal of the harm done is due to *dirt*, which, when the bandage gets moistened with the tears, produces an irritating action; besides which the bandage has then a poulticing effect. A light clean bandage frequently changed, then, should be used if any tying up is resorted to at all. Such a manner of tying up is free from most of the objections to keeping the eye covered. But it does not altogether get rid of them, as the light is necessarily excluded. Fresh air is not only good for the eyes themselves, but if a person with inflamed eyes, which are of an infectious nature, be kept in a close atmosphere with others, the contagion is more likely to spread.

Now, just as fresh air is most beneficial to the eyes, so is light. It is only where the deeper parts of the eyes are diseased that it is sometimes advisable to shade the eyes from light. The eyes should also be shaded when they are exposed to very strong sources of light. For most of the ordinary affections met with, it is a mistake either to shade the eyes, or to keep the individual in a darkened room. In many of the most common, and, often, at the same time, the least serious inflammations of the eye, especially in children, there is a great *dread of light* experienced. If this is encouraged, as is often done, and not unnaturally, either by keeping the child in a dark room for an indefinite time, or by allowing it to keep its eyes firmly closed and covered with its hands or a cloth, or its head buried in its mother's lap, or by carrying it about from place to place instead of allowing it to open its eyes occasionally to guide itself, the condition is much

more long continued, and, indeed, sometimes, what would otherwise be an unimportant disease, becomes, in this way, one which may leave the most serious consequences for sight. The prolonged treatment in dark rooms, so common in former days, seems to be fortunately rarely practised now. Such treatment is to be condemned altogether. It is not called for in any but the rarest instances. When it is advisable to temper the light falling into the eye, dark glasses are all that is required. The inconvenience of these to the patient himself is less, and there is, at the same time, no inconvenience to those round about him. But it is possible to abuse dark glasses too. Their constant use brings about a too great sensitiveness to ordinary light which is apt to develop into an extremely inconvenient habit. They should only be worn as long as there is an actual state of disease in the eye or eyes which calls for a diminishing of the light. For children who suffer from dread of light, a light brown paper shade over both eyes is all that is required. And here I may say that where there is any call for an eye-shade at all (except for the covering up of a deformity), the shade should cover both eyes. Many different forms of single shade are made and sold by druggists and instrument-makers. These are all useless, some of them positively hurtful, as they are lined with some poisonous-looking green silk, which soon gets moistened by the tears, and not unfrequently irritates the eye, if, as often happens, it fits too closely. I will ask you to try the following experiment at home. Hold both your hands in front of some friend's eyes whilst he is facing the light, one hand in front of either eye. You will notice that his pupils then become larger than they were when directly exposed to the light. Now remove one hand, you will then notice that the pupil contracts. Do the same again, only this time, instead of directing your attention to the eye from in front of which you remove your hand, look behind your hand at the other eye, which still remains shaded, and you will find that the removal of the hand from in front of the first causes the pupil of the shaded eye to contract too. This shows, therefore, that light falling into one eye affects in some way the other also. How it does so we need not pause to consider here. It follows, however, that if we wish to protect a diseased eye we must not only shade it, but the other as well.

The same applies, and with even more force, to reading. One frequently finds that people while shading one inflamed eye, so as to avoid reading with it, keep the other uncovered, and use it freely for reading. Just as when shading is required at all, both eyes should be shaded, so, if it be necessary to avoid reading with an inflamed eye, it is necessary to avoid reading altogether.

With regard to the operations which may be performed on the eye to improve or restore the sight which has been impaired by disease, there are a few popular notions to which it may be worth while referring. In the first place, let me say that it is impossible to restore sight by any operation when an eye is completely blind—that is to say, when with it no difference can be made out between the strongest light and the deepest darkness. There must always remain at least the power of appreciating light from darkness to render an improvement by operation possible. If this were generally known, many people would be saved long journeys only to be disappointed.

One queer idea which is no doubt familiar to many here is this: People are told that so-and-so had his eye "taken out, cleaned, and put back again." This I have often been told. I have even been told that I have been guilty of performing this extraordinary operation myself. Sometimes the individual in making the statement has come to believe that he saw it himself, and his faith is not shaken by anything you can say. I need hardly say that such a thing is impossible. If the eye were taken out it could not be put back again, any more than if the hand were cut off it could be replaced on the arm. But even if it could be replanted in the socket so as to take root, it could never be of any use for sight, as the optic nerve, which conveys the impressions of light to the brain, has been cut; and lastly, the eye cannot be cleaned.

There is, again, much misconception as to what can be done for the white or grey scars which remain on the clear part of the eye after ulcers. When these scars are very dense, and while not covering the whole of the clear part of the eye, are so situated in front of the pupil as to interfere greatly with sight, it is possible, by an operation which consists in altering the shape of the pupil, to more or less considerably improve the sight.

But the scars themselves cannot be removed. It is because they are confused with cataract that the idea that they can be "taken off," is very common. In some cases they gradually, in the course of a long time, clear up of themselves.

Cataract, that is to say an opacity of the lens of the eye, is, as everyone probably knows, a not uncommon defect, one can hardly call it a disease, of elderly people. That it can be cured by operation is probably equally familiar to most people. But it is not generally known that it cannot be cured by any other treatment but operation. Every now and then one hears of people who profess to do so, and of course they have dupes who believe that they have been benefited by their treatment, or who may have recovered their sight, but who then certainly never had cataract. Some friend tells a cataract patient of someone else who had cataract, and was cured by drops, and the rumour spreads. If you can meet with people ready to swear to having seen a man's eye "taken out, cleaned, and put back again," you are not surprised to find quite as circumstantial statements about cataract cured by drops. If those who so readily believe such stories would but for a moment consider the probabilities. In the first place, is it likely at this time of day that such a cure, if it were one, should only be known to one or two men? Supposing these to be men who had any respect for their profession or for whom the profession had any respect, they would deem it as great a sin as theft or even murder to keep to themselves the secret of what would be the means of benefiting so many thousands of people. They flourish on the gullability of their patients, all the while knowing themselves to be impostors, and quite content to forego the respect of others. Whereas if anyone were to discover a real and certain cure for cataract without operation, he would know that by making it public he would be amongst the most honoured of the benefactors of mankind.

Accidents to the eye are unfortunately not uncommon. So many different accidents occur which are more or less avoidable. A considerable proportion of all accidents occur in children. The eye may be pierced by scissors, needles, pins, sharp pieces of porcelain, or other substances. A pretty common and very distressing accident which children often meet with is the piercing of

the eye with a fork. This accident almost invariably occurs in the same way. The child has some difficulty in untying its shoe-lace, and uses one prong of a steel fork to undo the knot, the fork slips with a jerk, and penetrates the eye. I cannot too urgently warn you against allowing very small children to play with any sharp instruments at all, or older ones to run about with them, or use them for any other purpose than that for which they are intended. That is one point. But where any one should be so unfortunate as to have a child's eye injured in such a manner, proper advice should as soon as possible be obtained. It should be known that in severe injuries to the eye it is not only the eye injured but the other also which may be endangered, so that there is the dreadful risk of complete blindness. There is a reluctance on the part of many parents to bring their children at once after an accident has happened. This is greatly owing to their feeling some shyness at having to confess that, as is most frequently the case, they have directly or indirectly to blame their own carelessness. I am sure that few would let such considerations have any weight did they realise the full importance of the risks run.

There is not time to consider here the many different accidents which do occur to the eye from the breaking of stones, bursting of bottles, blowing out of corks, &c., many of which are preventable, if sufficiently simple precautions be taken. I must, however, conclude by drawing attention to a dangerous practice by which accidents may, and do, occur to the eyes of unwary individuals in our Edinburgh streets. I refer to the practice of chipping and chiseling paving stones in the open streets. No doubt here also those who are alive to the dangers of even a slight accident to the eye will either pass by beyond the reach of the flying fragments, or do as I invariably do myself, shade the eye on the exposed side with the hand. But the possibility of thus protecting oneself does not do away with the obligation on the part of the employers of the masons to provide some kind of screen which would render accidents of this nature impossible.

I have now done. It has not been my intention to teach you anything as to how to treat any of the many disorders of the eye,

but merely to warn you against being too ready with improper interference which may do harm. When we come to think what a small thing an eye is to be the external organ of the most important and marvellous sense, we may indeed be filled with amazement that it should be so comparatively rarely seriously injured. Surely we are bound to do everything to help to preserve that sense in others which above all others enables us to earn our daily bread. Is it not clear then that those who know nothing about it should not too rashly advise or undertake the treatment of eye diseases ?

THE ADVANTAGES OF A HEALTH SOCIETY TO A COMMUNITY.

By JOHN CHIENE, M.D., F.R.C.S.E.,
Professor of Surgery in the University of Edinburgh.

Ladies and Gentlemen,—To-night the Health Society of Edinburgh completes its tenth session. Six years have elapsed since it was my privilege to address the Society, and on this second occasion it may be advantageous to look back on the history of the Society and to ask ourselves this question, What has the Society done for the community in the last ten years, and what results have followed from the yearly lectures that have been delivered?

THE PAST WORK OF THE EDINBURGH HEALTH SOCIETY.

Many of the most able lectures were devoted to the structure of the human frame, and the importance of a clear understanding of the general laws of physiology. Such lectures are most valuable, their main significance and force depending on the impression which they made on those who heard them. Their value acted directly on the members as individuals, indirectly on the community as a whole. Good food and the advantages and cheapness of good cooking also received attention. Their value was also mainly to the individual. A healthy house and house sanitation appeal directly to the heads of households. Here again the community as a whole benefited only indirectly. These lectures may be spoken of as the education of the individual, and we cannot very well estimate their value; but in those wider questions, which have a more general bearing on the community, we are able

to mark out and intensify the good work done by the Society. In one of the first lectures that were delivered (that by Dr Smart on Preventible Disease) the keynote to many important reforms was struck. The importance of public baths was dwelt upon, and this was soon followed by the institution of the Corporation Baths, impressing on the public the importance of general and personal cleanliness. The importance of placing old buildings under the control of the Dean of Guild Court was also dwelt upon; and from a recent decision in the Second Division of the Court of Session which went against the Dean of Guild Court, it has been shown that the present law is not sufficiently stringent, and that overcrowding, with bad sanitation in any part of a tenement, in a way that may be injurious to the health of the other inhabitants of the tenement, is still consistent with the law of the land. In that lecture it is also noted that nothing short of the compulsory registration of infectious diseases will enable us to check and mitigate epidemics. At the time that the lecture was delivered this compulsory notification existed only in Edinburgh. At present it has spread throughout many parts of England, and I show you a map showing the present position of the compulsory notification in Scotland.

THE IMPORTANCE OF AIR SPACES IN A CITY.

Allusion is also made in Dr Smart's lecture to the importance of air spaces, and attention is directed to the good work done by the City of Edinburgh Improvement Trust, by which large numbers of insanitary houses were demolished and air shafts practically driven through some of the most densely crowded portions of the town. Miss Alison Dunlop in "Anent Old Edinburgh," while speaking of the Improvement Act of 1867, says. "It meant the purchase for destruction of a large portion of the Old Town, the annihilation of *cul de-sacs* and congeries of masonry, the construction of air-shafting streets through dense districts, where the breath of the population was blocked, and where even the breezes of breezy Edinburgh had ceased to blow." That Trust has recently been wound up, and I find that that Act has cost the ratepayers nearly £381,000, a large sum, raised by assessments, and coming directly out of the pockets of the taxpayers. The importance of air

spaces has been very persistently dwelt upon in these Health Lectures, and it has been shown that, unless we insist that all feuing plans are submitted to the Dean of Guild Court, that unless we thereby insure that sufficient air space is arranged for in each feuing plan, as years roll by, another Improvement Trust will need to be instituted, to drive air-shafts through districts that are now being feued and crowded to their utmost limit by buildings. Only the other day I observed, when our energetic Dean of Guild asked for such a feuing plan, it was refused by the architect, who was acting strictly within his legal rights, and it was evident that the Dean of Guild had not the power to compel him to submit a feuing plan before proceeding with the buildings. Look at what is going on in a suburb of Edinburgh at the present moment, and it will be evident that, if this state of affairs continues, those who come after us will require a public-spirited man, like the late Lord Provost Chambers, who will inaugurate a new Improvement Trust, for the purpose of giving more air in the parts of the town that are now suburbs. I specially ask you to remember that the cost of the working of such an Act is very great, that you have to pay for the privilege of putting your town in a sanitary condition,—an expense which would be entirely prevented if you gave your Dean of Guild Court more authority, and gave it power to see that no proprietor was allowed to cover his property with buildings which would afterwards be required to be pulled down at your expense, in order to give sufficient air space to the inhabitants. Builders, however, are now beginning to see that it is for their interest, in consequence of the better education of the people—thanks, in part at any rate, to the Health Society—to provide sufficient air space in a feuing plan. To illustrate this point, I direct your attention to a feuing plan at Wester Dalry [1] * in which the builder has arranged, not only for a pleasure-ground of $1\frac{1}{2}$ acres in the centre of his feu, but has taken care to ventilate what would otherwise have been an airless well, surrounded by houses.. All this is done in consequence of the force of public opinion, and it is evident that these airless wells will soon become a thing of the past. People are now beginning to fight shy of such wells. They have learned

* The figures in the text refer to sources of information for which, se Appendix.

that fresh air means health; that bad health means expense, and that it is cheaper in the long run to give a higher rent for a house with fresh air round it, than to live at a lower rent in a house, one side of which is imperfectly ventilated.

THE ISOLATION OF THE INFECTIOUS SICK.

Compulsory removal of the infectious sick when their presence in their own dwellings is dangerous to their neighbours is another improvement, and we cannot be sufficiently thankful that we have now in Edinburgh a well-appointed hospital for infectious diseases placed under the hands of the Corporation; and, recently, we have gone a step further in this direction, because we have a Convalescent Hospital at Musselburgh, to which patients can be transported from the City Hospital, and there maintained, until they can be returned to the community without risk of infection, and with a clear bill of health. One great advantage of such a Convalescent Home is, that poor children, whose constitutions have been enfeebled by infectious disease, are there fed up, and made more fit for again facing the rough life to which they are exposed. There is still a great class of patients in Edinburgh for whom at present there is no sufficient accommodation, namely, people suffering from consumption. It has been shown that one-tenth of the industrial classes in this country—that is about one million persons—suffer from the effects of their occupations, which effects very largely culminate in consumption. A special hospital for such was suggested by Sir Thomas Clark at the time of the Jubilee of the Queen, and it is to be hoped that the idea will not be lost sight of.

AMBULANCE INSTRUCTION.

The importance of the proper conveyance of the sick and wounded has also received a great impetus from this Society, and from the Edinburgh centre—which sprang from a lecture delivered in the hall—there has directly grown a number of other centres, as shown in the following map. Police cases are always now carried to the Infirmary on a well-appointed litter; and the other day I saw, with very special pleasure, two ambulance wag-

gons and three litters standing at the Infirmary gate. Such appliances save unspeakable suffering, and by these means the patients reach the hospital in a less exhausted condition. Let us see that we give our Ambulance Society sufficient support, so that they may be able to keep their appliances in the most perfect condition.

THE SUPERVISION OF MILK SUPPLIES.

The milk supply and the constant supervision of all dairies over the whole country has been repeatedly dwelt upon, and this session, Dr Woodhead has again brought the matter forcibly before you. It has been conclusively shown that one of the first works of the County Councils in the New Local Government Act will be an endeavour on their part to press upon the Government of the day the importance of carrying through a Health Act, which will ensure this inspection. Milk epidemics are now recognised as one of the worst features of civilized countries. I give you an illustration, kindly lent me by Dr Foulis, of one which recently occurred in Edinburgh, and I show the growth of such epidemics by reference to two milk epidemics in Glasgow, the illustrations being taken from papers by Dr Russell, the Medical Officer of Health for that city.[2] Milk is one of the few articles of diet which we take uncooked, hence its danger, and no doubt the future of a safe milk supply is to be found in an efficient and cheap way of sterilization. A ready means of effecting this is even now at hand in the boiling of milk before consumption—a proceeding which not only does not affect the quality of the milk, but even renders it rather more digestible.

THE DISSEMINATION OF LITERATURE ON HEALTH.

This reference to the past work of our Society would not be complete without specially directing your attention to the good work that has been done by the printing of the lectures delivered, and by the distribution of leaflets bearing on important sanitary points. When I tell you that 600,000 books, at a penny each, have been sold, besides leaflets, which have been distributed gratis by this Society, surely no one can help being impressed by the good work which the Society has done in the past.

THE FUTURE WORK OF THE SOCIETY.

So much for the past work of this Society. I now wish to direct your attention to some points in which it appears to me the Society can do good in the future.

THE NECESSITY FOR SANITARY EDUCATION.

First, it appears to me that they must press upon the School Boards in Scotland the immense importance of educating the children with regard to the simple laws of health. This matter has already received much attention in America, and in the Report published as long ago as 1881, by the State Board of Health of Michigan, a paper,[3] by the Rev. J. Morgan Smith of Grand Rapids, appears, in which he says: "We have a whole generation to educate in the rudiments of sanitation, and to know that scientific cleanliness is next to systematic godliness. I suggest that, instead of flooding the elect with convictions of which they are desperately convinced already, we print a sanitary primer, and have it taught in all our schools." He says, "I would make it very simple, in this way:

"LESSON I.

"What is Sanitation?

"The art of being Clean.

"What does Cleanliness mean?

"To keep our Bodies and Surroundings free from Dirt and Poison.

"Why should we be free from Dirt?

"Because the wages of dirt are death.

"What are the Elements of Cleanliness?

"Bathing, Pure Air, Sweet Food, and Drink, and agreeable smells."

"In Adam's dirt
We got much hurt."

The Rev. Mr Smith, whose opinion I have just quoted, says: "Thorough sanitation includes—

"1. Sanitary Education.
"2. Sanitary Inspection.
"3. Sanitary Construction."

1. As regards the sanitary education, I have just expressed my belief that this should be begun in our schools.

THE NECESSITY FOR SANITARY INSPECTION.

2. As regards the second head—sanitary inspection—power has recently been applied for by the Water Trust to see that our water-taps are not wasting water. One can perhaps see the advantage of water being wasted, when we remember that the water reaches our drains and flushes them. Any imperfection however in our sanitary arrangements can be nothing but an unmixed evil, and surely it should receive our most earnest attention. To put your drains in order is very important, but people seem to think that when this is once done the drains will always remain in order. Wear and tear tells on everything in this world, and drains are no exception to the general rule.[4] Inspection should be made as easy as possible, by the drains and plumber work being exposed. When a leak takes place it is thus more easily noticed, and the defect remedied with comparatively little cost. The covering up of our sanitary appliances is, to my mind, altogether mischievous. As regards sanitary inspection, the Sanitary Protection Society of Edinburgh has done an immense deal of good work, and many citizens have joined the Society, and their sanitary appliances are regularly inspected by the officers of the Association. The Burgh Engineer can now be called in, if we desire it, but it appears to me that the Burgh Engineer, instead of being called in after the mischief is done, and when disease has appeared, should periodically inspect the sanitary arrangements of every house, and should have the power to compel anyone to put his drains in order. At once, when this is proposed, the cry will arise that the liberty of the subject is interfered with. Any one joining a community cannot be allowed to exercise his liberty, if that liberty interferes with the health of his neighbour.

THE NECESSITY FOR SANITARY CONSTRUCTION.

3. Sanitary construction. The power of the Dean of Guild Court must be strengthened so that, for example, no one will be allowed to ventilate his water-closets into the common stair;

in other words, to make the passage to his neighbour's house a ventilating shaft for his water-closets. This surely is a liberty which should be summarily interfered with. The most powerful antiseptic is fresh air, and it will need to be the law of the land that pigeon holes and the windows of water-closets are not analogous terms. A check must also be put on the sub-division of houses which is now going on in our city—a proceeding necessarily followed by imperfect sanitary arrangements. The Health Society must in the future do all in its power to encourage the registration of plumbers and architects. In these two professions, at present, the public have no guarantee that the men they employ have received a proper education in sanitary construction. The art education of architects should, I think, never be interfered with by statute: it must grow un- tramelled, and its standard must be public opinion, apart fr statutory control. The sanitary education of our architects apart from their artistic training. Much has been done already in this direction. There are many most intelligent men in both of these professions, but it is for their protection, as well as for the protection of the community, that their registration should be under statute.

THE COST OF SICKNESS.

All these improvements will cost money, but it has already been shown in a lecture delivered to this Society that the yearly expense to the city, in two diseases only, scarlet fever and typhoid, was over £40,000, and this was at a time when no epidemic existed. In the case of an epidemic, we may take the expense of the smallpox epidemic at Sheffield during 1887-8,[5] which was nearly £27,000, and "it is to be noted that this expenditure is but a fraction of the total money loss to the inhabitants, because it takes no note of the loss of wages during illness, expense of doctors, maintenance of sick, cost of funerals, etc. The actual loss to the trade of Sheffield cannot be guessed at. Sheffield was avoided by all outsiders. The hotels were empty, the Sheffield people were boycotted by the inhabitants of neighbouring towns, and all excursion trains to and from the town were stopped, and during the year

the tramways carried 200,000 people fewer than usual. The pecuniary expenses themselves cannot be estimated. The amount of misery and suffering is beyond all estimate." In connection with the history of the smallpox epidemic in Sheffield it is specially worthy of note that at the time of the epidemic, health societies or associations were founded by the people of Sheffield,—societies for the conservation of their health, and Dr Barry reports that much good was done by these societies, and that they exerted a very important influence in checking the epidemic. Assurance societies were formed, the infectious sick were separated from the healthy, and during their separation they were supported out of the funds provided by the insurance fund. 33,000 members joined these associations and spent £5,300 during the epidemic. It is worthy also of note that in one of the largest firms in Sheffield the fund has been made permanent. These facts are surely sufficient to show that from the money point of view the expense of the prevention of disease is a mere flea-bite to the expense of sickness. The total expenses of the Health Committee last year in this town were £9,400. This looks a comparatively large sum, but it is a mere nothing to the incalculable good that is done by the committee. Increase its officers tenfold, and the money thus spent will be returned over and over again with compound interest to the inhabitants. It was with extreme regret that I observed the other day that the Lord Provost's Committee had dropped all the sanitary clauses in the proposed Braids Bill. It is the duty of the Health Society to strengthen the hands of sanitary reformers in the Council, and to do all they can as individuals to make sanitation a crucial question at the municipal elections, and to see that the sanitary clauses in any future Bills are not dropped because of a fear that they will be opposed and the Bill lost. There is one point in the Prospectus of our Society which has not received, in my opinion, sufficient attention—the redelivery of the Society's lectures in lectures in the neighbourhood of Edinburgh.

THE COMPULSORY NOTIFICATION OF INFECTIOUS DISEASES.

With the great facilities for travelling the whole of this country has become so to speak, one large town. From the railway re-

turns I gather that over all, each person in Scotland spends on an average ten shillings a year on travelling. There is free intercommunication between every part. Edinburgh and Glasgow, for instance, are one city. The communication is now complete. Last year upwards of 700,000 people travelled between the two cities. At the present time Glasgow cannot obtain a Local Act. The Police and Health Acts for Scotland stop the way, and they are told, when they apply for an act, that there will soon be a general act for Scotland which will do away with the necessity for local acts. Country people are coming into the towns. In the towns they become infected. They return to their country homes carrying infection along with them, and many of the epidemics in outlying districts gain a hold in a small community, which hold would never have been obtained if the Compulsory Notification Act was general over Scotland. The Infectious Disease (Notification) Act of 1889 makes this now possible over the whole of Scotland; any Local Authority may adopt it, and I quote, from the letter by the Board of Surpervision to the local authorities of Scotland, the opinion of the Board. "The Board are strongly of opinion that no time should be lost by the Local Authority in availing themselves of the provision of the Act, with the view of checking the spread of infectious disease within their district. The experience of the Local Authorities who have already exercised similar powers under Local Acts, proves that the notification of cases of infectious disease by medical practitioners and others is of unquestionable utility in the protection of public health." In England eighty urban and rural districts have adopted this Act, representing a population of 2,000,000, besides the fifty-nine who previously exercised the power under Local Acts. Thus among one half of the whole population of England the notification of infectious disease is compulsory. It is with sincere pleasure that I observe that Glasgow leads the van, and has adopted the Infectious Notification Act, and has set an excellent example to the whole of Scotland, which, I am informed, has already been followed by eleven local authorities. Towns-people go to country places and sea-side resorts for health, and through infected milk, imperfect drainage, and bad water, instead of health they get disease. The county councils soon to be instituted have a great work before them. They *must* appoint

by the Act medical officers. The word "may" in the Bill, has, thanks to our legislature, been replaced by the word "must" in the Act. They must see that these men are in no way hampered in their endeavours to prevent and mitigate disease. There is an unfortunate blot in the Local Government (Scotland) Act. It was hoped by reformers at one time that all medical officers would be free from other employment. It is sincerely to be hoped that the County Councils will not take advantage of the loophole afforded by the Act, and that they will require that their medical officers shall work for them, and them alone. They must give them full power over all the sources of milk supply. They must adopt the Compulsory Notification Act, and they must require that there be a Central Board in Scotland, to whom weekly returns of all infectious complaints occurring throughout the whole of Scotland are submitted, and these weekly returns must be tabulated, and intimation sent to all the public medical officers in Scotland, so that each medical officer may be forewarned, so that, when suspicious illness arises in an individual who has come from an infected district, he may, with such knowledge, be able to step in and check the commencing epidemic in the bud. There must be a yearly convention of all the medical officers in Scotland, and at this convention the experiences of the last year may be formulated and discussed, and new measures and new precautions adopted for the coming year. These, ladies and gentlemen, are some of the suggestions which I beg to offer to the Health Society as work for the future. In the capital of Scotland our Society must always take a leading part. I have tried to show that this country is one large community closely bound together by ties which render it necessary that we must have one code of laws for our self-preservation.

THE NEW POLICE AND HEALTH BILL.

We must press upon the Government the necessity of passing at an early period the Public Health Act which has been so long on the stocks. If it cannot be passed in its present form let us endeavour to get the public health clauses passed, and let the police clauses come under a separate Act. The Bill at present, containing as it does many clauses, has become so very cumber-

some, that I cannot but think that its passing would be facilitated by this subdivision. In the last report of our energetic and esteemed Burgh Engineer [6] we find some most interesting data bearing on the necessity of a new Public Health Bill. In St Giles' Ward we have the maximum density in Edinburgh—900 persons to each acre. If at the present moment a builder adopted the minimum limit, on an acre of ground he could place 960 persons; in other words, he could place on each acre more inhabitants than at present live in the most densely populated part of our city. It is fortunate that the feuing builder is more generous than the Act. Two feuing plans, one in the east and one in the west, are given in this report, with an average density of 579 and 657 persons per acre respectively. If the present provision of the last edition of the Police and Health Bill were adopted, and became the law of the land, the utmost limit would be 600 persons per acre. At present the town is at the mercy of any one who takes his pound of flesh. This should not be the case. Public opinion and the increased knowledge of sanitary requirements by the public are at present the only safeguards against greater crowding in our newly feued districts than at present exists. In the most crowded parts of our city, as the Burgh Engineer well puts it, "The very worst existing conditions of density of houses and population in the slums of our city may be more than realised under the Act of 1879, which is the law which at present regulates building operations in Edinburgh."

THE SLUMS OR PLAGUE SPOTS OF A CITY.

In every city slums or plague spots exist. Their inhabitants are characterised by improvidence. They live from hand to mouth; they spend as much money on drink as on lodging, food, and clothing; they contribute nothing to the general good,—they are spenders. Dr Russell of Glasgow gave recently a graphic account of the inhabitants of the plague spots in Glasgow.[7] Our Burgh Engineer, Mr Cooper, in his last report [8] gives us much interesting information regarding the slums of Edinburgh, and both writers ask what is to be done with them. The people are a stain on our character, they pull us down, they are to the community as a black sheep in a respectable family. In Glasgow

they number 85,000 out of a population of 750,000, or 11 per cent. In Edinburgh 40,000 in a population of 300,000, or 13 per cent.

They consist of three great divisions :—

1. Hereditary slummers.

2. Slummers who have degenerated from a better class by improvidence.

3. Those who, from no fault of their own, by misfortune, have joined the ranks of slummers.

I have no means of telling you the proportion of each of those classes to the whole army. I doubt not that the third class, the poor whom we must always have with us, are in the minority. Dr Russell gives them at 20 per cent.

THEIR REMOVAL.

The great question of the future, What can we do to help them or get rid of them ? is a most difficult problem. The education of the children is the main stay in the attack on this evil, and free education surely will be an important help in removing individuals from this unproductive class. The better housing of these people, so as to give them self-respect, can only be undertaken by the communinity in which they reside. A Peabody and a Guinness may help, but it lies with the community as a whole, through their municipal authorities, to do the work. Increased rates will frighten some from even considering this way of solving the difficulty. I hold that it would pay us to do so. These people live at present on our charity and our rates, and they now do nothing but spend our money. We are supporting them now ; we are paying their rents, clothing them, feeding them, and supplying them with drink. Dr Russell, to my mind, proves this conclusively. I think the Health Committee of Edinburgh have done what from a purely business point of view is the right thing. They recommend, with regard to St Giles' Ward, " that whenever uninhabitable houses or other property situated in this densely populated district can be acquired at a reasonable figure, such property should be secured by the town, for the purpose of being reserved as open spaces, and for the improvement of the sanitary condition of the locality." The facilities for drink must

be diminished; their drink bill must be lessened by taking every care not to renew licences in the districts which have obtained so unenviable a reputation. The Health Committee also remark on this as follows:—"After consideration of statistics relating to St Giles' Ward, the committee is of opinion that the number of licensed houses in the district is largely in excess of its requirements, and that by the temptation thus offered to those with little self-control, the work of the committee is opposed, and many evils caused, some of which are expressed in inferior houses and a high death-rate. The committee therefore recommend that the Town Council should put these opinions before the Magistrates with a request that they should, as opportunities present themselves, reduce the number of licensed premises in this ward." [8] We must see that our charity is given properly. Much at present goes directly to the drink shops in the slums. If we give food, these people sell it to get drink. They drink because they are miserable; their misery is in their surroundings. It is self-evident that if they had better houses, which can only be supplied by the municipality, their self-respect would increase and their drink would be lessened. While I feel that they will always be with us, it is very evident that any successful endeavour to lessen the whole numbers will be a direct benefit to the community as a whole. Every individual who is carried from the debit to the credit side of the ledger, every one who from being unproductive becomes productive, every one who is rescued from the ranks of improvidence and joins the provident classes, is a direct saving to the rates, and becomes himself a ratepayer instead of a ratespender.

CONCLUSION.

To-night I have only been the mouthpiece of the Members of the Health Committee of this city, the Dean of Guild Court, the Medical Officer of Health, and the Burgh Engineer, in bringing these matters before you. I have omitted much that might have been said. I trust that I have said nothing that had better been left unsaid. What is good in my advice please accept, what is bad in my advice please forget, and let each member of the community remember that if he individually does his duty in sanitary matters the work of our sanitary authorities will be greatly

lightened. Let each member of the community remember that ordinances, statutes, and regulations can never take the place of personal example. I trust that if I have tried to speak forcibly I have not spoken unkindly. There is much to be thankful for in the ten years that have passed by since this Health Society was instituted by patriotic citizens. This Society has done good work in the past, much work remains for it yet to do, and it is my earnest hope that it may receive that encouragement which will enable it to continue to stimulate public opinion, and to educate the people to the immense importance of good health.

APPENDIX.

1. Memoranda for use in the Dean of Guild Court. Edinburgh, 1888.

2 (*a*). Report by Medical Officer on an outbreak of enteric fever in Glasgow. August, 1884.

(*b*). Lectures on the Theory and General Prevention and Control of Infectious Diseases. By J. B. Russell, M.D. Glasgow, 1879.

3. Report of State Board of Health. Michigan, 1881.

4. See "The Plumber and Sanitary Houses," by S. Hellyer.

5. Report by Dr Barry, one of the Medical Officers of the Local Government Board, entitled "Epidemic of Smallpox at Sheffield during 1887-8." London, 1889.

6. Annual Return of Sanitary work of the Burgh Engineer's Department. Edinburgh, 1888-9.

7. Sanitation and Social Economies, by Dr Russell, Medical Officer of Health for Glasgow; Proceedings of Philosophical Society of Glasgow, 6th November 1889.

8. Report on the Sanitary Condition of St Giles' Ward, by Burgh Engineer. October 1889.

The following facts are brought out in this Report:—

(1) Number of people in St Giles' Ward living in insanitary houses, about 9000.

(2) Number of overcrowded houses, 375.

(3) Number of uninhabitable houses, 176.

(4) Death Rate, 1888—City, 19·02 per 1000; St Giles', 26·79 per 1000. During first half of 1889—City, 16·05; St Giles', 22·11.

(5) Of 8139 Police Offences in City 2690 (nearly one-third) occurred in St Giles'.

(6) Rental of Shops for Sale of Drink in St Giles', £14,500; Rental of Shops for Sale of Food in St Giles', £11,570.